

J. L. Baillie, Jr.
June 16/39

THE

ex lib. Rev. C. J. S.
Bethune.

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Science

HALIFAX, NOVA SCOTIA

VOLUME XV

PART 2

SESSION OF 1919-1920



HALIFAX

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THE attention of members of the Institute is directed to the following recommendations of the British Association Committee on Zoological Bibliography and Publications:—

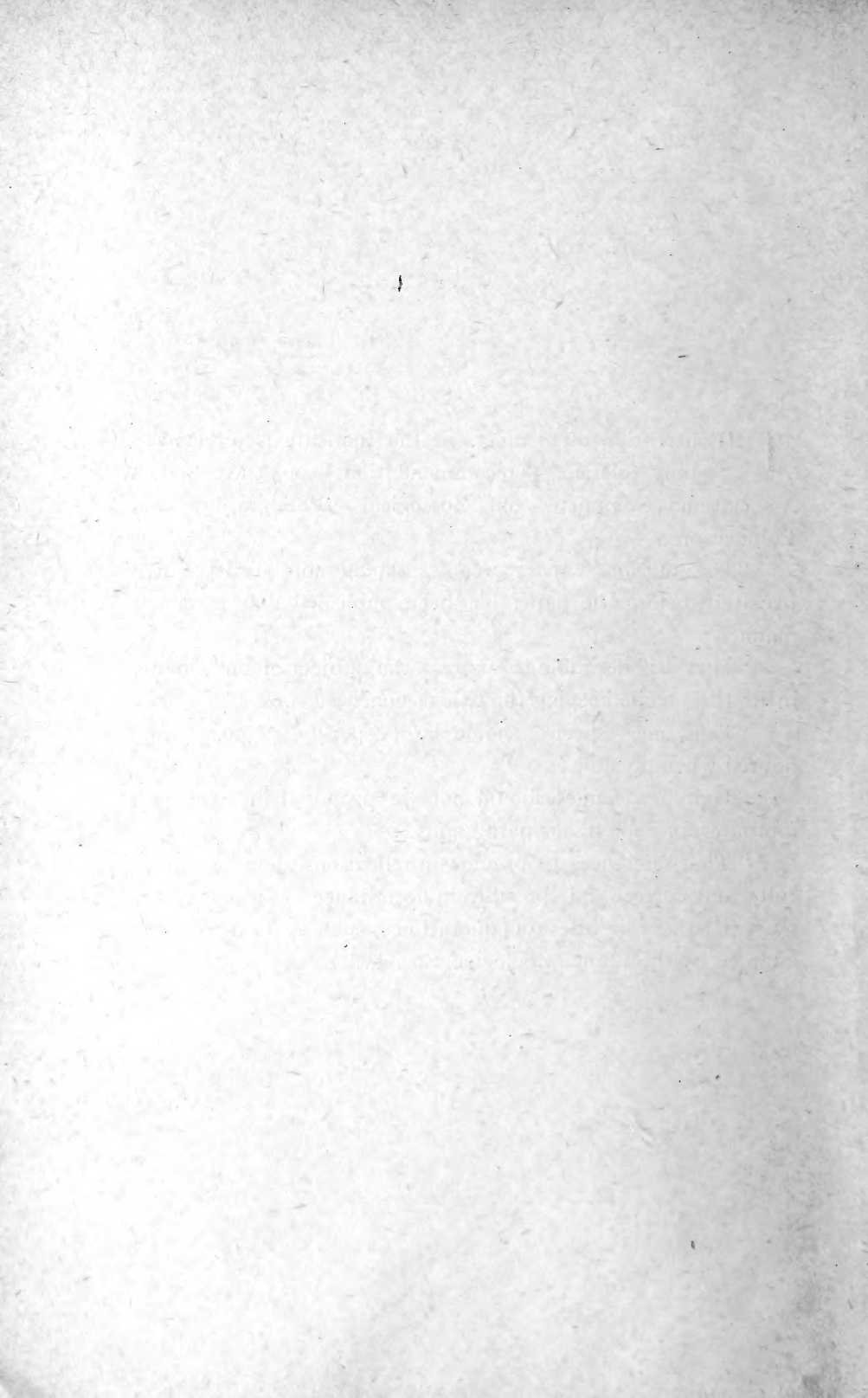
“That authors’ separate copies should not be distributed privately before the paper has been published in the regular manner.

“That it is desirable to express the subject of one’s paper in its title, while keeping the title as concise as possible.

“That new species should be properly diagnosed and figured when possible.

“That new names should not be proposed in irrelevant footnotes, or anonymous paragraphs.

“That references to previous publications should be made fully and correctly, if possible in accordance with one of the recognized sets of rules of quotations, such as that recently adopted by the French Zoological Society.”



PROCEEDINGS
OF THE
Nova Scotian Institute of Science

SESSION OF 1919 - 1920

(Vol. XV, Part 2)

58TH ANNUAL BUSINESS MEETING,

*Physiological Lecture Room, Dalhousie College, Carleton St.,
Halifax, 10th November, 1919.*

THE PRESIDENT, DR. H. L. BRONSON, in the chair. Other members present: PROF. C. J. CONNOLLY, DR. E. MACKAY, D. J. MATHESON, DR. A. H. MACKAY, PROF. D. S. MCINTOSH, C. B. NICKERSON, DR. J. CAMERON, DR. D. FRASER HARRIS, DR. J. H. L. JOHNSTONE, P. R. COLPITT, DR. W. W. WOODBURY, E. CHESLEY ALLEN, DR. S. G. RITCHIE, B. R. COYSH, F. C. CHURCHILL and H. PIERS.

THE PRESIDENT in his opening remarks stated that the society's efforts to increase its membership had met with success, the number of members being nearly doubled. The membership list had also been generally revised. The council was considering what might be done by the society to further the cause of science in a more popular and general way, and a committee had been appointed to deal with the subject, but was not ready to report. Reference was made to the loss sustained during the year through the death of MAJOR GENERAL HARDY, who had been the last surviving original member of the Institute, 1862, and who died at Dover, England, on 11th April, 1919; of DR. DONALD A. CAMPBELL, who died at Halifax on 7th January, 1919; and of REV. ROBERT LAING, who died on 19th April, 1919.

PROG. & TRAN. N. S. INST. SCI., VOL. XV.

PROC. III

By request of the President, MR. PIERS briefly sketched the career of GENERAL HARDY and spoke of his interest in all that related to this province and its natural history as well as in the affairs of the Institute which he assisted in founding.

The Treasurer, MR. MATHESON, presented his financial report for the year ended Oct. 1919, shewing that the receipts were \$1,103.93, the expenditures \$185.95, and the balance in hand \$917.98 (in current account), while the balance at credit of the reserve fund was \$361.48, and the permanent endowment fund, invested in Maritime Telephone bonds, was \$1,000.00. The report was received and adopted.

On motion, \$500.00 will be invested in Victory Bonds, and placed to the credit of the permanent endowment fund, as representing life-fees.

The Librarian's report was presented by MR. PIERS, showing that 1,163 books and pamphlets had been received through the exchange-list during the calendar year 1918. The total number of books and pamphlets received by the entire Provincial Science Library (with which that of the Institute is incorporated) for the same year, was 1,432. The total number in the Science Library on 31st Dec. 1918, was 60,890. Of these, 44,390 belong to the Institute, and 16,500 to the Science Library proper. 128 books were borrowed in 1918, besides the many consulted in the Library. No binding or purchasing had been done by the Library directly, there still being no grant at its disposal. The report was received and adopted.

DR. A. H. MACKAY laid on the table copies of the Transactions, vol. xiv, part 4, which had recently come from the press.

The following were elected officers for the ensuing year (1919-1920):

President—PROFESSOR HOWARD LOGAN BRONSON, PH.D., F.R.S.C., *ex officio* F.R.M.S.

First Vice-President—PROFESSOR C. J. CONNOLLY, PH.D. (Antigonish.)

Second Vice-President—PROFESSOR JOHN CAMERON, M.D., D.Sc., F.R.S.E.

Treasurer—DONALD J. MATHESON, B.Sc.

Corresponding Secretary—PROFESSOR EBENEZER MACKAY, PH.D.

Recording Secretary and Librarian—HARRY PIERS.

Councillors without office—ALEX. HOWARD MACKAY, LL.D., F.R.S.C.; PROFESSOR DONALD SUTHERLAND McINTOSH, M.Sc.; CARLETON BELL NICKERSON, M.A.; PROFESSOR DAVID FRASER HARRIS, M.D., D.Sc., F.R.SS. E. C.; E. CHESLEY ALLEN; STEPHEN GALWAY RITCHIE B.A., D.M.D.; and CAPTAIN JOHN H. L. JOHNSTONE, M.Sc., M.B.E.

On motion of DR. E. MACKAY, the PRESIDENT, PROF. CONNOLLY and MR. PIERS were appointed a committee to consider means by which the Institute could extend its usefulness.

FIRST ORDINARY MEETING.

Physiological Lecture Room, Dalhousie College, Carleton St. Halifax, 10th November, 1919.

The first ordinary meeting was held on the conclusion of the annual business meeting. The PRESIDENT, DR. BRONSON, in the chair.

PROF. DONALD SUTHERLAND McINTOSH, M. Sc., Dalhousie University, read a paper entitled "Port Hood Harbour: its Past, Present and Probable Future." (See Transactions, p. 71) The subject was discussed by DR. A. H. MACKAY, MR. PIERS and PROF. CONNOLLY.

SECOND ORDINARY MEETING.

Physiological Lecture Room, Dalhousie College, Carleton St., Halifax, 19th January, 1920.

THE PRESIDENT, DR. BRONSON, in the chair.

It was reported that PROF. DONNELL BROOKS YOUNG, B.Sc., PROF. ROY AUBREY SPENCER, B.Sc., M.Sc., EBENEZER W. TODD, B. Sc., and DR. FRANK W. RYAN, proposed on 10th Nov., had been elected ordinary members by the Council in December.

The following papers were read by title:

- (1) Scattered Notes of a Field Botanist in Brittany, France, during the War.—By MAJOR J. H. BARBOUR, R.A.M.C., F.L.S., St. Omer, Pas de Calais, France.

(2) The Blue Crab (*Callinectes sapidus* Rathbun): Extension of its Range Northward to near Halifax, N. S.—By HARRY PIERS, Curator of the Provincial Museum, Halifax. (See Transactions, page 83).

On motion from the CHAIR, seconded by PROF. McINTOSH, it was unanimously resolved that the Nova Scotian Institute of Science desires to place on record its profound sense of loss in the death from pneumonia on the sixth day of January, 1920, after an illness of eight days, of PROFESSOR EBENEZER MACKAY, PH.D. (J. H. U.), MacLeod Professor of Chemistry in Dalhousie University. He was a member of the Institute from 1889, from 1907 to 1910 its President, from 1899 a member of the Council, and for the last few years the efficient Corresponding Secretary. As he was only in his fifty-sixth year, full of vigor, incessantly active, happy and hopeful; an ideal trainer of students in science; the most tactful and generous of collaborators; his death is a profound loss to the Nova Scotian Institute of Science, as well as to Dalhousie University and the science of Chemistry in Canada. Even in the affairs of the city of Halifax his usefulness in aiding many public improvements has created demonstrations of sorrow for his loss which have rarely fallen to the lot of an educationist.

It was further resolved that an obituary notice and portrait of the late Dr. Mackay be inserted in the proceedings. (See page xxvii.)

PROF. D. S. McINTOSH reported that he had received an interesting specimen of Inyoite from Hillsboro, New Brunswick, a mineral which formerly had only been reported from California, U.S.A.

THIRD ORDINARY MEETING.

*Physiological Lecture Room, Dalhousie College, Carleton St.,
Halifax, 9th February, 1920,*

THE PRESIDENT, DR. BRONSON, in the chair.

The election of a Corresponding Secretary to fill the vacancy caused by the death of DR. E. MACKAY, was left to the Council.

C. B. NICKERSON read a paper by PROF. H. JERMAIN M. CREIGHTON, D. Sc., F.C.S., Swarthmore, Penn., U. S. A., on "Variation in the Composition of Compressed Illuminating

Gas with Pressure as it issues from the Compression Cylinder." (See Transactions, page 91) The paper was discussed by DR. BRONSON, DR. A. H. MACKAY, C. B. NICKERSON, E. W. TODD, and DR. S. G. RITCHIE.

HARRY PIERS, Curator of the Provincial Museum, Halifax, read a paper on the "Accidental Occurrence of the Pygmy Sperm Whale (*Kogia breviceps*) on the Coast of Nova Scotia: an extension of its known range." (See Transactions page 95) The subject was discussed by DR. MACKAY, PROF. D. B. YOUNG, F. C. CHURCHILL, PROF. CAMERON, DR. S. G. RITCHIE, and others.

FOURTH ORDINARY MEETING.

*Physiological Lecture Room, Dalhousie College, Carleton St.,
Halifax, 8th March, 1920.*

The SECOND VICE-PRESIDENT, DR. CAMERON, in the chair.

It was announced that WILLIAM G. ROBERTSON, Halifax, proposed on 9th Feb., had been elected an ordinary member by the Council.

PROF. D. FRASER HARRIS, M.D., D.Sc., F.R.S.S.E. and C., Dalhousie University, read a paper on "The Descent of Man in Medicine," illustrated with charts and lantern slides. A vote of thanks was presented to the lecturer.

On motion of MR. PIERS and DR. HARRIS, it was resolved that the N. S. Institute of Science convey to the publishers and editors of *Nature*, London, its congratulations on the occasion of the fiftieth anniversary of the establishment of that well-known scientific journal, and wish them continued success in the future.

FIFTH ORDINARY MEETING.

*Munro Room, Dalhousie College, Carleton St.,
Halifax, 12th April, 1920.*

THE PRESIDENT, DR. BRONSON, in the chair.

It was announced that RALPH F. HOPKINS, Halifax, proposed on 8th March, had been elected an ordinary member by the Council.

A letter was read from the editor of *Nature*, thanking the Institute for its resolution of 8th March.

PROF. JOHN CAMERON, M.D., D.Sc., F.R.S.E., Dalhousie University, read a paper entitled, "A Contribution to the Ethnology and Craniology of the Eskimos of Southampton Island, Hudson Bay," illustrated by lantern slides. The subject was discussed by DR. A. H. MACKAY, G. W. T. IRVING, H. PIERS, A. B. WISWELL, and others.

SIXTH ORDINARY MEETING.

*Physiological Lecture Room, Dalhousie College Carleton St.,
Halifax, 10th May, 1920.*

The PRESIDENT, DR. BRONSON, in the chair.

On motion, PROF. DONALD S. MCINTOSH was elected Corresponding Secretary to fill the unexpired term of office of the late DR. E. MACKAY.

A paper by FREDERICK C. CHURCHILL of Wolfville, N. S., on "An Abandoned Marine Sand-bar in the Cornwallis Valley, N. S." was read by MR. PIERS. (See Transactions page 65.) The subject was discussed by PROF. MCINTOSH, E. W. TODD, DR. BRONSON, MR. PIERS and the author.

A paper by PROF. H. JERMAIN M. CREIGHTON, D. Sc., Swarthmore, Penn., on "A Convenient Form of Burette for Exact Gas Analysis," was read by C. B. Nickerson in the author's absence. (See Transactions, page 115). The paper was discussed by DR. BRONSON, MR. NICKERSON, and MR. TODD.

The following papers were read by title:

"The Spring Bird Migration of 1914 at Antigonish, N. S."

—By HARRISON F. LEWIS, Quebec, P.Q. (See Transactions, page 119.)

"Phenological Observations, Nova Scotia, for 1919"—By

A. H. MACKAY, LL.D., F. R. S. C. (See Transactions, page 56.)

A discussion took place as to the selection of papers for publication, the cost of printing having very greatly advanced of late, and resulted in matters being left in the hands of the Council.

A vote of thanks was passed to PROFESSORS HARRIS and CAMERON for the use of their lecture-room as a place of meeting.

HARRY PIERS,

Recording Secretary.



PROFESSOR EBENEZER MACKAY,
B. A. (Dal.), Ph. D. (J. H. U.)

Born, 1864; Died, 1920.

President of
N. S. INSTITUTE OF SCIENCE,
1907-1910

OBITUARY NOTICE OF EX-PRESIDENT
PROFESSOR EBENEZER MACKAY,
B.A. (Dal.), Ph.D. (J.H.U.)
1864-1920.

On the 6th of January, 1920, a great science teacher died in Halifax after about a week of illness from pneumonia, struck down in spite of the best medical skill after one of the most busy sessions of the Chemistry Department of the University of Dalhousie, of which he was the very efficient head.

Ebenezer Mackay was born January 24th, 1864, at Plainfield, at the foot of Mount Dalhousie, Pictou County, Nova Scotia. He was the son of Angus and Elizabeth Mackay, the father coming out from Rogart, Sutherlandshire, Scotland, as the youngest member of a large family, whose descendants have already figured well in the history of Canada.

Ebenezer had a good grounding in the rural school. He carried off honors in the Pictou Academy, and graduated from the University of Dalhousie in 1886 with first-class honors in experimental physics and chemistry, and the Mackenzie Gold Medal.

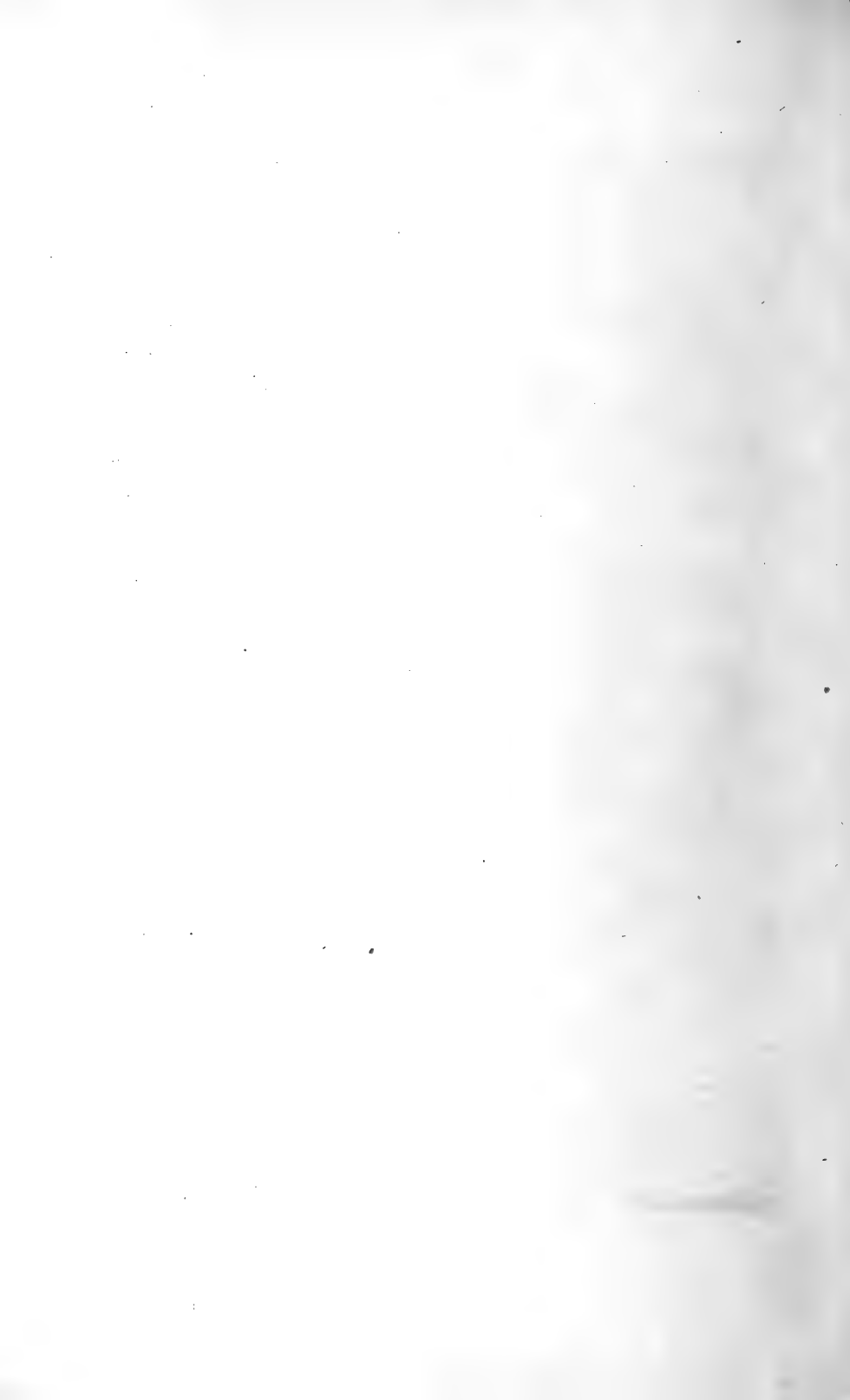
He was Principal of the High School and the Public Schools of New Glasgow, Pictou County, from 1886 to 1892, where he had great success. He then took a post-graduate course in the Johns Hopkins University, became a Fellow in 1895, and graduated Ph. D. in 1896. He was engaged in a special research course of study at Harvard when appointed to the McLeod Professorship of Chemistry and Mineralogy in Dalhousie, 1896, after which he became a resident of the City of Halifax, and one of the active members of the Nova Scotian Institute of Science.

He was elected a member 27 November, 1889, and became President, 11 November, 1907, and was continued in this office until 12 December, 1910. He was elected President of the "Greater Halifax Conference" in 1911; and later filled many high positions in scientific, educational, social and civic departments.

His urbanity of manner, his unassuming demeanor, his accuracy of language with minimum expenditure of words, as well as his encyclopedic knowledge, his self-reliance, coupled with a most genial and sympathetic disposition, endeared him to all, from the rural school to the great scientific fellowships, and also to the general public which had often commandeered his services. He was the soul of honor and friendship.

The tragedy of his unexpected removal in the prime of his powers, and at the beginning of the fruition of his career, appealed profoundly to the general public as well as to the members of the Institute, as was shewn in the public obsequies on the occasion. His students were becoming important contributors to original research for which the Institute was organized as a stimulus. The torch had been suddenly flung down; but, *Vitai Lampada!* it is being caught up by those who learned to play the game.

A. H. McK.



TRANSACTIONS
OF THE
Nova Scotian Institute of Science
SESSIONS OF 1919-1920

(Vol. XV, Part 2.)

PORT HOOD HARBOUR: ITS PAST, PRESENT AND PROBABLE
FUTURE.—By D. S. McINTOSH, B. A., M. Sc., *Professor of
Geology, Dalhousie University, Halifax, N. S.*

(Read 10 November, 1919)

INTRODUCTION

To an observant watcher by the seashore, the work of storm waves is readily apparent. The seeming ease with which the sand, pebbles and larger fragments of rock are moved about cannot fail to be noted. When the waves strike so as to make an oblique angle with the shoreline, the undertow is changed into a current which sweeps material along the coast instead of carrying it directly seaward. If the cliffs are reached by the storm, the waves hurl loose portions of rock from the beach against them, gradually wear them back, and sweep the debris along in the direction of advance. The shoreline is thus being worn away in one place and built up in another; the land mass is being reduced, while bars and shoals are forming on and near the strand line. With each succeeding storm this activity is repeated, and it needs but length of time to greatly alter the contour of the coast. Like most of the natural processes, the action of the waves along the shore is slow in making noticeable changes, and what is observed by one generation may be lost to the next. Hence, the necessity of records of change which may be invaluable to the future geographer.

The collection and preservation of data that had been neglected and were in danger of being forgotten was the motive that prompted the writer of this paper. Interest grew with the work, however, and its scope has been enlarged so as to present what, in the writer's opinion, is the probable development of Port Hood Harbour into a safe natural haven, the manner in which it became changed into a less safe refuge, and, likewise, to attract attention to the probable future of the port.

LOCATION OF PORT HOOD' HARBOUR.

The County of Inverness embraces the western side of Cape Breton Island from Cape St. Lawrence to the Strait of Canso. From Cape St. Lawrence, the general trend of the coast line is south-west for about eighty-five miles in a straight line to Cape Linzee near Port Hood, the shiretown of the County. From here it bends south with an easterly component and extends to Point Tupper, about thirty-five miles. Two islands lie off the coast to the south west of Cape Linzee and are a continuation of the north-east trending land to the north, and formed at one time an integral portion of it. The outer or Henry Island is over a mile beyond Smith Island, the larger of the two. The latter island is situated a mile from the mainland and opposite the town of Port Hood. Between Smith Island and the mainland is the harbour which is the subject under consideration. (See Fig. 1.)

EVENTS OF THE DISTANT PAST.

It is a *far cry* from the Port Hood Harbour of today to the time in which the coal-measures were laid down. The rocks around the harbour are associated with that period of time. They are

1. Just au Corps (Just' au Corps) corrupted by the English to Chestico, was a former name for Port Hood. Mr. Brown in his History of Cape Breton, quoting from a report on the state of the island, says that "the Acadians had built small vessels during the winter of 1764-65 at Just au Corps seven leagues to the northward of the Gut of Canceau, for the French merchants at St. Pierre and Miquelon." There is added as a footnote:

"Mr. Morris states that during the French occupation of the island, fifty men were constantly employed at Just au Corps quarrying freestone for Louisburg and the French forts in the West Indies." Port Hood is the name used by Brown in reference to grants of land made during Macormick's administration, begun in 1787. This name appears also on Desbarres' charts, and was given the place in honour of Admiral Hood of the British Navy.

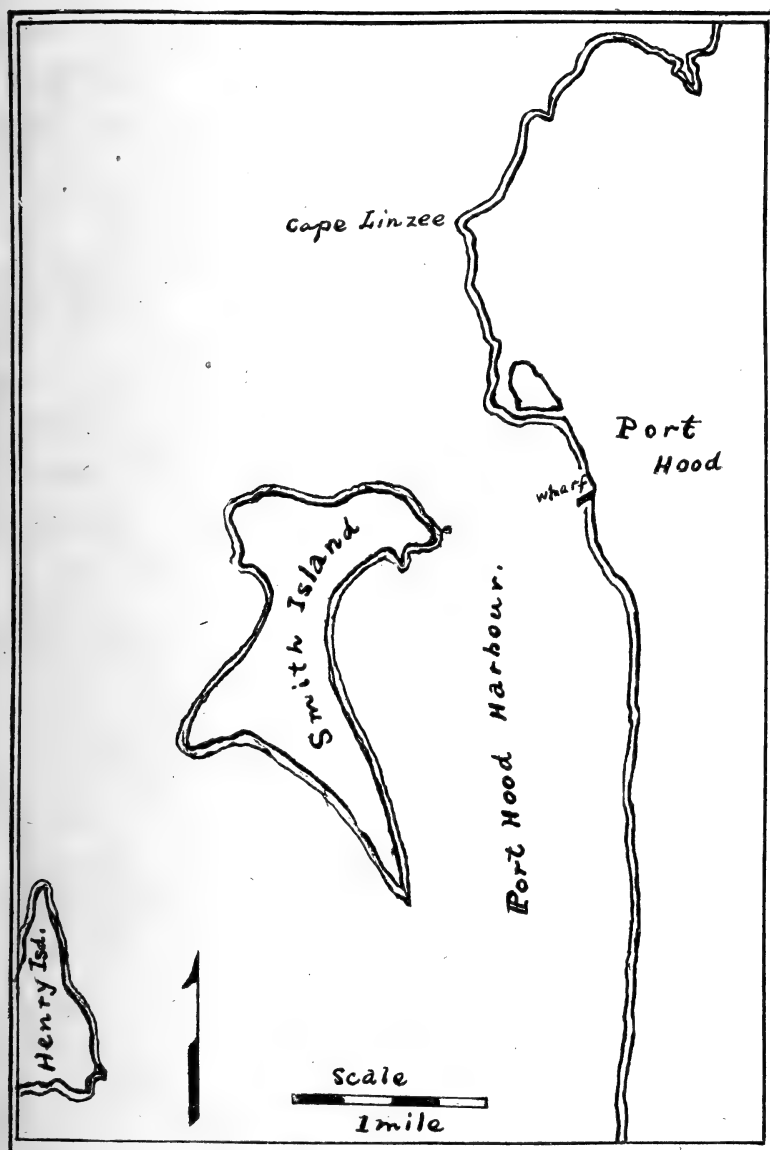


FIG. 2. SKETCH-MAP. PORT HOOD HARBOUR OF TO-DAY.

sedimentary, and one must realize that there was a time in the long, long ago when here was a shallow sea in which sand and mud were being deposited in alternating beds with layers of gypsum and sea-shells, and where at various times great swamps existed in which grew the vegetation from which the coal of today resulted. A glance at a geological map of the Island will show that what is now Cape Breton was then a much smaller land area made up of individual parts into and around which the sea extended. It had, however, topographical features similar to those of the present landscape, as the valleys of today are found to be floored by these same sedimentary rocks that are seen at Port Hood. The plateau of older rock that today occupies the larger part of the north and interior of the Island existed as today, but the sea entered all the old valleys drowning the rivers for a long distance towards their sources. Through succeeding ages, the sediment laid down in the sea was changed. The mud, sand, and gravel became consolidated into hard rock; the shells became limestone; the vegetation, coal; and the gypsum grew firmer. Slowly the land emerged from the sea, and not unlikely the area where is now the Gulf of St. Lawrence became land, and the old St. Lawrence and other streams made their way seaward and emptied far beyond the coast line of today. Onwards through the vast stretches of time the land was undergoing change—now elevation, now subsidence; but always were the sub-aerial forces at work removing material from a higher to a lower level, and the ocean waves beating upon the coast tearing away here and building up there. A general subsidence of the land allowed the sea to flood the lower course of the St. Lawrence and cover a large part of the surrounding area, and thus brought about the St. Lawrence Gulf, the waves of which are now pounding upon the Inverness coast. A period there was also, during which the whole country was covered by ice as Greenland is today, and this event also left its impress upon the land. These long-continued processes, at length, resulted in the physical features of today with a somewhat more extensive land area.

THE LESS DISTANT PAST AND ORIGIN OF THE HARBOUR.

In the less distant past, the land stood some scores of feet higher in relation to the sea than it does today. The continuous

action of the waves was, however, gradually reducing the extent of the land, and its height was being lessened by weathering and running water. In the course of time a line of weakness was found on the seaward side, and a portion was detached from the land mass and formed Henry Island.

It cannot be stated with certainty how the harbour came into existence, but there is evidence that points strongly to the probable way. Its location was an area of structural weakness. (See Fig. 1.) The rocks on the present landward side and on the greater part of Smith Island form a part of the Coal Measures. Smith Island has a fringe of the Lower Carboniferous on the northern end, showing also on both sides on the shore underneath the rocks of the Coal Measures. Here is the contact of the two formations, and the upper beds of the lower series consist of soft shales, gypsum, marl, etc. which yield easily to eroding forces. The harbour length is along the strike of these rocks. It is not unlikely, also, that this is a broken or faulted area. The soft rock and the attitude and conditions of the beds were, thus, such as to lend themselves readily to rapid wear whether to sub-aerial or wave processes. The slope of the land was in all probability southward, and it may be said with a good deal of certainty that a gentle sloping valley developed about the middle portion of the area largely through stream and general erosion and that it lay open to the south. A slow subsidence of the land bringing it to about the present level allowed the sea to enter this valley depression. The sinking of the land was general along our coast. All our rivers show it. The sea enters their lower courses. Mabou river, some few miles north of Port Hood, has its lower valley drowned. The tidal waters extend inland to Mabou village some five miles. A depth of fifty feet of water in the Mabou river channel would indicate a sinking of that extent at least, probably much more, as the channel bed has silted up largely since the subsidence. The harbour of Port Hood thus began as a submerged valley of erosion. On the northern side of the depression the rocks were more resistant hard sandstone and withstood the wave attacks and the general weathering, so that the harbour lay sheltered from the northern gales by a neck of land perhaps a half-mile wide.



Fig. 2. PORT HOOD HARBOUR. (Reduced from Desbarres' Chart, 1781.)

EVIDENCE OF FORMER LAND CONNECTION.

The discussion up to this point has been based upon known geological changes in the earth's history, and the probable results of processes at work under conditions that very likely existed. That they may be questioned, the writer is well aware. No doubt, however, exists as to the presence of a land connection where is now the northern entrance to the harbour.

In the Legislative Library at Halifax are three volumes of unique charts owned and used by Admiral Lord Nelson, and presented to the Library on August 21st, 1885, by Vice-Admiral Sir J. E. Commerell, K. C. B., V. C. They were published for use of the Royal Navy of Great Britain by Joseph F. W. Des-Barres, and bear the date of 1781. Two of these charts, plates 3 and 33, are of the western coast of Cape Breton and show the harbour of Port Hood, with the depths of water in the harbor and around the coast. Henry Isle is separated from the nearest land by shallow water with two narrow channels three fathoms deep. What is now Smith Island is joined to the mainland and the connecting neck is marked "Sand hills," but at four places, two near each end of the neck, is the conventional sign for "Cliffs of red earth." (See Fig. 2.) These red banks must indicate underlying rock above high water mark. It is probable that the original rock extended from each side, and that towards the middle the sea had worn it down, so that at high tide or during heavy gales some water passed to and from the harbour. The customary sand grasses would cover the sand hills.

On the plate, a part of which is shown in Figure 2, is the following in engraved script;—"Port Hood, situated on the north-western extremity of the Island of Cape Breton, bears by compass North 4° East distance twenty miles from the north entrance of the Gut of Canco, and East 8° South $17\frac{1}{2}$ miles from Cape George. The Flood Tide sets from ye Northward at from Cape George. The Flood Tide sets from ye Northward at the rate of one and half miles an hour and on the days of Full and Change it is High Water at half-past seven. Common Spring Tides rise about five feet. To sail in, keep your course to the Eastward till Point Emersion is on with the Gut of Canso; this direction will lead you into no less than six fathoms water, and close by the end of the Sand Flatt which runs from the South-east part of the Peninsula, here are two small remarkable white

beaches at the bottom of the cliffs. When the Southermost bears W. by S. you may haul around by the anchorage in four and five fathoms water and muddy bottom, where ships may lie well sheltered from all winds. The water on the Flatts appears very white, and breaks when ye wind blows strong from the southward.

"There is a passage for small vessels between Point Susannah and Henry Isle."

In the Crown Lands Office in Halifax are old land grants which show that late as 1826 the northern entrance was closed. On one grant the connecting strip of land is divided into cross lots from end to end of the neck, six in all, evidently for fishing purposes. The narrowest part of the neck on this grant, which bears date of 1826, is about six chains. There appears to be some doubt about the accuracy of these plans, as a grant of 1823 on which the land connection is much narrower has written upon it: "A dependance can be placed on this plan.—T. Crawley, Sur-General."

There is also available evidence of personal recollection. The writer is indebted to Mr. N. H. Meagher, until recently a Judge of the Supreme Court in his native province, for the following: "My father came to Nova Scotia about 1820 or 1821 and for a time lived at Port Hood. At that time there were a number of Smiths living on the inner Port Hood Island. A daughter of one of these married a man named Hayes—a Catholic. The visit of the priest to Port Hood at that time was a very rare event, and when one came, my father was sent over to the island to notify the Hayes family of his presence on the mainland. Sometimes he made the journey to the Island on foot, and at others on horseback. At that time a small stream would cross the sand bar when high tides occurred—and only then."

THE IMMEDIATE PAST.

There is, therefore, accurate knowledge of Port Hood Harbour as it existed somewhat less than a hundred years ago. As a haven for ships it ranked high. It was excellently protected from wind and wave. Lying open to the south-west, it would not be affected much by a storm from that quarter as the reach of outside water in that direction is not great. The approach lay open giving easy accessibility. The channel was sufficiently wide with a depth at the shallowest part of six fathoms. No

bars obstructed it, although a sand shoal had built out nearly half the width from the western side about a third of the distance from the mouth. There was, however, sufficient water in a wide channel east of this. The depth of water in the harbour varied from four to six fathoms. The anchorage was safe. There was freedom from strong or high tides and from fog. One drawback it had then as now, ice interfering with navigation for something like three of the winter months.

A False Move and Serious Results.—The abundance of fish around this coast early attracted men to the sea. The homes of the fishermen were around the harbour, but the best fishing grounds lay to the north. To reach the banks it was necessary to make a wide detour south and around the island. A channel for boats could easily be made across the isthmus from the head of the harbour to the open sea. This would be a great convenience. Accordingly at the lowest part of the beach a passage for boats was cut through. This was left unprotected in any way, and soon the waves and currents widened it making great inroads on both sides, until at the present day the channel is about three-quarters of a mile wide with a maximum depth of one and a-half fathoms. In less than a hundred years, therefore, a neck of land three-quarters of a mile in length has been removed by the ceaseless action of the waves.

The Change a Gradual One.—For a time after the opening of the northern entrance, the harbour retained its main former characteristics. Fishermen from other parts frequented the fishing grounds and sought refuge here. Some three-score years ago when the "North Bay" was the favorite mid-summer haunts of the American mackerel hookers and seiners, Port Hood was a noted rendezvous. More than a hundred schooners of the fleet were often at anchor at one time in its capacious harbour. Many interesting accounts of the time are related of the encounters between law-breakers and coastal-guard cutters. Our own countrymen were often to be found among the fishermen, and frequently figured in the escapades. Capt. Patillo of the schooner "Highland Lass" seems to have been one of the ablest and most daring of these mackerel catchers. His ability to locate fish was well known. Should the fleet be around the Magdalen Islands at night-fall, and in the morning the "Highland Lass" be missing, Patillo had surely sailed for Port Hood

through the night, and accordingly the whole fleet would follow. His hair-breadth escapes from the cutters were also the common property of the fleet.

THE PRESENT CONDITIONS.

The removal of the land protection on the north left the harbor open to the northerly and northeasterly gales which are the most severe along this coast. The seas sweep in and it is difficult to maintain a wharf on the Port Hood side. The land on both sides of the harbour has suffered much from the waves. In this connection, Mr. Meagher says: "In my own recollection when I went to school at Port Hood in the winter of 1863 the land extended out, I am quite sure, as far as, if not further than the head of the present public wharf. There was an old Catholic Church, the first at Port Hood, situate some distance to the southward and eastward of the present pier, and was, I believe, as far out from the present shoreline as the head of the pier. There were some old buildings there too—one of them a store belonging to Peter Smythe. They disappeared years ago. I am under the impression that there was an old meeting house there too. The school boys in the spring of the year were in the habit of going to the shore and having contests to see who threw down the largest area of sod which had been undermined several feet by the action of the sea." The harbour has silted up to some extent at the middle and at the southern end, and many of its fine features as a haven of refuge are gone. It now partakes of the type of harbour determined by a shelter behind an island. In this regard it compares favourably with others of that type. The old anchorage still remains with Smith Island serving as a protection from the north and west winds. The island side serves also as a safe shelter for the fleet of fishing boats, and a site for the wharves and buildings connected with the fisheries which continue to be valuable. On the mainland side towards the southern entrance, a coal shipping pier was built some years ago. It appears not to have been adversely affected by the waves, but the shifting sands have, doubtless, lessened the depth of water around.

THE PROBABLE FUTURE.

In the ordinary course of natural events, the harbour must be destroyed, providing the coast remains stationary. The

island is wearing away somewhat rapidly. For thousands of years, however, it may exist as an inferior type of natural haven, and serve as a port. The current through the northern entrance is such as to preclude the probability of the island being in time tied to the mainland by a sand bar, and thus renewing the old condition.

What nature may not do, may, however, be done by man. It is possible to close the northern entrance artificially. The attempt was begun in 1903 when the sum of nearly three thousand dollars was spent. Work on the project was continued each succeeding summer up to 1912, the whole expenditure being upwards of one hundred and thirty-five thousand dollars. The plan of operation consisted in building a structure across the channel from a point a short distance above the public wharf to extend to the nearest point on the island. Stout twigs were made into mattresses, these sunk and ballasted. Work was done on both sides of the channel, but has not been resumed since 1912. The project is referred to by the Chief Engineer as the "proposed closing of the northern entrance," and he says "the estimated cost is approximately five hundred thousand dollars at present prices for labour and material."

But a new danger threatens the sheltered portion of the harbour. On the northern end of the island about 250 feet from the shore at the channel, there begins a weak place in the rock, and this extends westward for about 600 feet. This is probably the same kind of rock and structure which led at first to the depression that formed the harbour. The cliff here is about 30 feet high and from it the ground slopes southward for about 650 feet to a pond on a level with the sea. This pond is separated from the best sheltered part of the harbour by a narrow sand beach about 60 feet wide over which at very high tides the sea enters the pond. Now this northerly facing cliff of soft rock is rapidly wearing away under the attacks of the northerly storms. Last year, it is stated, the sea advanced about 15 feet. As it is cutting into a southerly sloping area, it is likely to progress more rapidly as the work goes on, unless the increasing length of the cove it forms becomes a deterring factor. It is, at any rate, evident that in fifty years or so, this place may be cut across and a small island be left where is now the headquarters of the fisheries for the Port

Hood Island. This part of the island, therefore, needs to be protected artificially to preserve the present harbour.

Like many other harbours, that of Port Hood has a tragic side to its history. On December 17th, 1876, the schooner *Maggie H*, Capt. McLellan, from Bonne Bay, Newfoundland, was wrecked there. The newspaper report describes her as a vessel of 90 tons register, 10 years old, built at Boston and owned by Capt. Murdoch McLellan of Port Hawkesbury. Besides the crew of nine men, there were on board, as passengers, a man and his wife and three children. Two members of the crew and the three children were lost. The remainder of the crew and passengers were rescued by Mr. H. A. Smith, of Port Hood Island, and his three brothers, each of whom received a silver watch from the Government in recognition of his humane act. The newspaper of the same date contains also the following:—"A despatch to the Marine and Fisheries received yesterday states that the barque *Minerva* of Charlottetown was ashore at Port Hood, full of water, and was breaking up. The second mate was drowned in attempting to land."

In the preparation of this paper the writer has received valuable help from several sources. He wishes to acknowledge his indebtedness to Mr. Harry Piers of the Provincial Museum, who acquainted him with the presence of the charts in the Legislative Library, to Miss Donohoe, the efficient librarian of that institution, to Mr. R. M. Smith, of Port Hood Island, for information and some measurements on the island, to the officials of the Crown Lands Office, and to Dr. A. W. Chisholm, M. P. for Inverness County, for statistics regarding the work of closing the northern entrance to the harbour. Grateful acknowledgements are due also to Mr. N. H. Meagher, who took a keen interest in the work from its inception, and furnished material and helpful suggestions.

THE BLUE CRAB (*Callinectes sapidus* Rathbun): EXTENSION OF ITS RANGE NORTHWARD TO NEAR HALIFAX, NOVA SCOTIA.—BY HARRY PIERS, Curator of the Provincial Museum of Nova Scotia, Halifax,

(Read 19 January, 1920.)

Callinectes sapidus, the Blue or Common Edible Crab of the Atlantic coast of the United States, and the only northern form of the genus, was, until 1895, known as *Lupa* (*Callinectes*) *hastatus* of Say. It is not the *Lupa hastata* of Desmarest, and therefore was assigned its present name by Miss Mary J. Rathbun in a paper on "The Genus *Callinectes*" (Proc. U. S. Nat. Museum, vol. 18, p. 349, Wash., 1895). It belongs to the family *Portunidae* (the swimming Crabs), which is distinguished by the last pair of pereopods (legs) being broad and flattened at the end, thus forming effective paddles for propulsion.

Range.—Up to now the most northern locality from which it has been recorded is Millpond, an inlet of Salem Harbour, Massachusetts, U. S. A., where a single individual was taken as recorded by C. Cooke in the *American Naturalist*, vol. 1, p. 52, 1867. It is occasionally found in Massachusetts Bay (Smith, Rept. U. S. Com. Fish and Fisheries for 1871-2, p. 548, 1874). It is common in bays and at the mouths of rivers from Cape Cod, Mass., to the northern extremity of Texas, and is especially abundant in Chesapeake Bay, where it is the basis of an extensive industry. Specimens have been taken also in the Bermudas, Jamaica, and Brazil; but outside of the region from Cape Cod to Texas it is of rare occurrence. Dr. J. F. Whiteaves makes no reference to it in his Catalogue of Marine Invertebrates of Eastern Canada, Ottawa, 1901, nor do any later writers mention its occurrence north of Salem Harbour. Dr. A. G. Huntsman of the Biological Board of Canada informs me that they have never obtained it in any of their investigations along the Atlantic coast, and he knows of no reference to its occurrence in Canadian waters. Mr. William MacIntosh, curator of the Museum of the Natural History Society of New Brunswick, St. John, tells me that he has no record of its having been taken along the New Brunswick coast.

Habitat.—It occurs on muddy shores and bottoms, down to deep water, and among eelgrass, being particularly abundant in bays and in the brackish waters of estuaries; and has even

been taken in fresh water contiguous to the coast. During the summer it is found in relatively shallow water; but retires in winter to greater depths. Adults are more often obtained in deep water; but the young, as well as some adults, come inshore to water only a few inches in depth.

Economics.—Next to the Lobster, this crab is the most important food crustacean of the United States, it being extensively eaten both in the hard- and soft-shelled stage, and is highly esteemed.* Any extension of its range is therefore of considerable general interest.

Occurrence on the Nova Scotian coast.—In the Provincial Museum of Nova Scotia, Halifax, when I took charge of it in 1899, was an old dried specimen of an adult female *Callinectes sapidus*, but without any data. As there were a few foreign crustaceans in the collection, I did not then consider its presence of any significance.

On 8th November, 1902, I purchased from a Miss Icton, in the Halifax market, two specimens of the species, a male and an immature female, which had been found alive, cast up with kelp on the sand beach at Cow Bay, Halifax County, N. S., on 7th November, and which had been boiled and so turned red. A third one, an adult male, had been taken with the others, and was obtained for the Museum on the following market day. I requested the woman to look for more, and accordingly other specimens from the same place were obtained from her in November and December of that year, and in April and May, 1903; making in all fourteen specimens. One of them was alive when I received it, and the others quite fresh.

Two more specimens, a male and an immature female, were taken on 8th May, 1903, in what is known as the Lily Pond, a brackish lagoon, immediately behind the Cow Bay sand-and-gravel beach. This lagoon is now connected with the sea at high-tide by a narrow channel at the southwestern end of the beach. Up to about 1901 the water of this pond was fresh, being fed by a couple of brooks, and white waterlilies flourished there; but about that year a new outlet was broken through and since then the water has been brackish. The pond is

* "Soft-shelled" crabs are those met with two or three days after moulting, before the shell has become hard. The period between moults is from 15 to 25 days, according to whether the individual is young or approaching maturity. The usual period of life is about three years, and the number of eggs laid about 1,750,000.

shallow, and the bottom mostly sand, overlaid with decaying organic material.

The place where all these specimens were obtained was at the southwestern end of the sand beach, near the present outlet of the Lily Pond, or Cow Bay Pond as it is sometimes called, about four-fifths of a mile southwest of the Mosher house. The two which were collected in brackish water were taken in the adjoining pond, close to the outlet, and therefore in the immediate vicinity of where the others were found in salt water.

Cow Bay itself is on the Atlantic coast, seven miles in a direct line east-southeast from the city of Halifax, in Halifax County, and lies between Hartling Point on the west and Osborne Head on the east. It has a long beach of sand and gravel, exposed to the full inward sweep of the Atlantic Ocean.* The locality is very scantily settled by farmers.

One male Blue Crab was obtained from Beazley and Henrion, fish dealers, of Halifax, who told me it had been taken at Cole Harbour, Halifax County, on 25th November 1902; but as Cole Harbour is about three miles northeast from Cow Bay, and it is the only specimen reported to have come from there, I think it very probable that it also came from the latter place. The dealer had purchased it from someone living in that district, and may have mistaken the name of the exact locality, as such details were of no interest to him.

All of the Cow Bay specimens were obtained in the Halifax market from one woman, who then lived in that district, and they were taken by her brothers. She told me that no one about Cow Bay to whom the crabs had been shown, had seen the species before. Since the spring of 1903, this woman has ceased coming to the market, and I have not since happened to note any of the crabs exposed for sale. I am therefore not in a position to state whether the colony still exists at Cow Bay, but there can be hardly any doubt that it does, as it seemed to be well established.

Besides the Cow Bay occurrence, I am only aware of this species having been once taken elsewhere in Nova Scotian waters. Mr. E. Chesley Allen, formerly of Yarmouth but now of Halifax, informs me that he identified a single adult specimen of *C. sapidus*

* For an account of Cow Bay beach and its pond, see McIntosh, Prof. D. S., A Study of the Cow Bay Beaches, Trans. N. S. Inst. Sc., vol. 14, pt. 2, p. 109, 1906.

which he obtained in a fish-market in Yarmouth. It had been taken on the shore at Sandford, just outside of the mouth of the Bay of Fundy, Yarmouth Co., six miles north-northwest of the town of Yarmouth, N. S., about the year 1921. No person of the district had met with the species before, and it is the only specimen Mr. Allen has noted in this province, although he has carefully examined the shore about Yarmouth for marine invertebrates. His specimen has since been lost. On the coast at Sandford there is, I believe, a lagoon or cove which is separated from the sea by a roadway.

Summary of specimens.—In all, seventeen specimens and the right cheliped of an eighteenth one, have been received by the Museum from the Cow Bay district, exclusive of the old female, without data, which we suppose must have been also collected here. Of the 18 complete specimens, 12 are males, immature and adult, varying in greatest width from 4.20 inches to 6.03 inches; and 6 are females, varying in width from 4.30 inches to 5.90 inches. Of the females, 2 are adults with the distinguishing broad, rounded abdomen, and 4 are immature specimens with wedge-shaped abdomens.*

Grouped as to months in which they were taken, we get the following result; April, 6 specimens (all male); May, 3, (2 males and 1 immature female); November, 6, (4 males and 2 immature females); and December, 2, (both females, immature and adult). These scant figures indicate that they may be most common in April and November. It is possible that during the more busy summer season they were not searched for. In the winter they no doubt retire, as elsewhere in their range, to the bottom in deeper and warmer water, but they are met with on shore as early as the later part of April and as late as 11th December. In Chesapeake Bay, Va. and Md., U. S. A., they are most abundantly taken in May or June, and in October or November.

Particulars of Nova Scotian specimens.—On the next page are given particulars of the eighteen complete specimens and one cheliped of *Callinectes sapidus* in the Provincial Museum:

* Unlike the case of the female, we have no criterion by which to distinguish adult males from immature ones, except so far as size and general appearance is indicative of age, unless one can make observations on sexual activity.

ACCESSION NUMBER	SEX	AGE	LOCALITY	DATE	CARAPACE	
					LENGTH	GREATEST WIDTH
Old specimen	Female	Adult	Nova Scotia (?)	Not known.	Ins. 2.25	Ins. 4.65
1073	Male	.....	Cow Bay, Hfx. Co., N. S.	7 Nov. 1902	2.55	5.26
1073	Female	Immature	" " " " "	" " "	2.35	5.09
1077	Male	.....	" " " " "	" " "	2.75	6.03
1078†	"	.....	" " " " "	14 " "	2.50	5.36
1098	"	.....	Cole Har. (?) Hx. Co., N. S.	25 " "	2.36	5.14
1099	Female	Immature	Cow Bay, Hfx. Co.	27 " "	1.96	4.30
1125	"	.....	" " " " "	11 Dec. "	2.18	4.82
1126	"	Adult	" " " " "	" " "	2.52	5.90
1811	Male	.....	" " " " "	24 Ap. 1903	2.46	5.30
"	"	.....	" " " " "	" " "	2.46	5.12
"	"	.....	" " " " "	" " "	2.64	5.70
"	"	.....	" " " " "	" " "	2.46	5.26
"	"	.....	" " " " "	" " "	2.31	4.74
"	"	.....	" " " " "	" " "	2.28	4.73
(Right cheliped)	?	.....	" " " " "	" " "	.....	.....
1815	Male	.....	" " " " "	1 May "	2.73	6.00
1820	"	.....	Cow Bay Lily Pond, Cow Bay	8 " "	1.98	4.20
"	Female	Immature	" " " " "	" " "	2.00	4.35

All specimens were obtained from one person, except the "old specimen" and No. 1098.

† Alive when received.

12 males: average length, 2.457 ins.; average width, 5.237 ins.

6 females: average length, 2.210 ins.; average width, 4.852 ins.

2 adult females: average length, 2.39 ins.; average width, 5.28 ins.

Males vary in size from the smallest (No. 1820), 1.98 ins. in length, 4.20 ins. width, to the largest (No. 1077), 2.75 ins. length, 6.03 ins. width.

Females vary in size from the smallest (No. 1099), 1.96 ins. length, 4.30 ins. width, to the largest (No. 1126), 2.52 ins. length, 5.90 ins. width.

Largest immature female is No. 1073, 2.35 ins. length, 5.09 ins. width.

All of these specimens agree fully with descriptions and figures of *Callinectes sapidus*. The following notes on the colour were made from Acc. No. 1078 (male), which was alive when received, and No. 1077 (male) which was quite fresh, and represent fairly well the colouration as found here, which agrees generally with that of more southern specimens:

Colour.—Carapace greenish-olive, passing into olive-green on posterior margin. Tips of teeth on anterior margin of carapace and of lateral spines, reddish. Underparts generally white. Legs (periopods) pale olive-green and blue; their callosities and spines red. Upper part of chelae ("pincer-claws") dirty olive-green; inner side of same, a fine cobalt blue.

In Chesapeake Bay, U. S. A., 36 adult females had an average width of 6.117 inches, and they are known to attain a width of 7 inches; and the average width of adult males is there probably about 6.5 inches at least, while they are known to grow to a width of 8.5 inches.* As our two adult females (with rounded abdomens)

* Churchill, E. P., Life History of the Blue Crab, Bull. Bur. of Fisheries, vol. 36, 1917-18, p. 101, Wash., 1919.

only measure 4.65 inches and 5.90 inches, and the males are all 6.03 inches or less in breadth, we are lead to the conclusion that our Nova Scotian individuals undergo their final moult and so attain maturity at a smaller size than do those of the more favourable southern coast. This is as might be expected on the extreme northern extension of the geographical range, where suitable food may not be so abundant, and the torpid winter condition may be slightly longer, as this crab becomes sluggish when the temperature of the water falls below 50 degrees.

Conclusion.—We thus see that at this northern locality on the Atlantic coast of Nova Scotia, in latitude $44^{\circ} 37'$, there is a remarkable and apparently well-established and comparatively numerous colony of this important species of crab, which previously had never been recorded from Canadian waters, or even from further north than Salem Harbour, Mass., situated in latitude $42^{\circ} 30'$, nearly four hundred miles to the southwest. It seems truly remarkable that this crab has not been found in the Bay of Fundy, except the single specimen from Sandford, Yarmouth Co., or even on the coast of Maine.* It would be interesting to know if it occurs in suitable localities elsewhere along our Nova Scotian Atlantic coast, or whether at Cow Bay and Sandford, we have isolated colonies whose origin may have been casual individuals, or even a single egg-bearing female, borne northeastward on the Gulf Stream and thence straying to our shore. This current has brought many unexpected marine visitors from the south. Such accidental crustacean wanderers, if cast upon a favourable part of the coast, where suitable food occurred, could multiply and establish themselves. The marked swimming ability of the family to which the Blue Crab belongs, may lend strength to such an explanation of the origin of such colonies here, should subsequent observations indicate that the species does not occur in the intervening area between Nova Scotia and Massachusetts.† Nothing at present indicates that the Cow Bay colony and the Sandford individual are the survivors of an occupation which once extended unbroken up to this latitude.

* See Rathbun's List of Crustacea of New England, 1905.

† W. P. Hay (Life History of Blue Crab, Rept. U. S. Bur. of Fisheries, 1904, p. 401, Wash., 1905) says the species is one of great activity and considerable power of endurance. It progresses through the water by a sculling motion of the broad hind legs, and under ordinary conditions it moves slowly, its efforts apparently being to keep afloat while it is borne along by the current. In this way it might easily go adrift and be carried northward by the set of the Gulf Stream.

Previous references to these specimens.—It may be mentioned that in notes on interesting accessions published in the Report on the Provincial Museum for 1902 (appended to the Report of the Department of Mines), Halifax, 1903, page 5, I briefly referred to our first specimens as "several Blue Crabs (*Callinectes sapidus*), new to this province, taken at Cow Bay"; and in the report for 1903 (Halifax, 1904, page 6), stated that in that year "a number of Blue Crabs (*Callinectes sapidus*) have been obtained from Cow Bay and Eastern Passage, showing that this species has an established habitat in the province." This reference to the Eastern Passage I cannot now explain, as that locality is not given for any of the specimens recorded in our accession-book or on the labels, and it is without doubt a mistake, although at the time of then writing I must have had some reason for thinking that the species also occurred near the sandy Eastern Passage, an arm of Halifax Harbour, which adjoins Cow Bay to the westward.* As these brief records were buried in the before-mentioned reports, it seems well to draw attention more formally to such an interesting and unexpected extension of the geographic range of an important economic species.

Summary.—1. The Blue Crab (*Callinectes sapidus*) occurs as a fairly numerous colony at Cow Bay, on the Atlantic coast of Nova Scotia, seven miles east-southeast from Halifax, and possibly at immediately adjoining favourable localities. A single specimen has also been taken at Sandford, Yarmouth County, at the mouth of the Bay of Fundy. It occurs in both salt and brackish water, but apparently rarely in the latter.

2. No previous records are known of its occurrence to the north of Salem Harbour, Mass., and the question naturally arises whether in Nova Scotia we have merely isolated colonies established by casual drift individuals borne northward by the Gulf Stream and cast upon our shore; or whether, less likely, they are the survivors of a continuous occupation which once extended this far north. Further search should be made to

*Since writing the above, I have met the woman from whom I obtained the Cow Bay specimens of this crab which are in the museum. She had been a Miss Icton of Cow Bay, but is now Mrs. Soward of Purcell's Cove, N. W. Arm. She assures me that all the Blue Crabs I obtained from her were taken at the southwestern end of Cow Bay beach, near the outlet of Cow Bay Pond, about 4/5 mile southwest of the Mosher house. She has never heard of any having been taken in the Eastern Passage or elsewhere

discover if the species exists elsewhere on our coast to the southward of Halifax, from which region, with the exception of Sandford, it has so far not been reported.

3 Inhabitants of the districts where it was found, had not noted the species before, which, although not evidence of much weight, tends to increase the probability that it had been introduced by natural agencies within comparatively recent years.

4. Individuals from Nova Scotia seem to mature when of a slightly smaller size than do those of more southern regions, but this is not sufficiently pronounced to be at all varietal.

Provincial Museum. Halifax, N. S.,
12th December, 1919.

VARIATION IN THE COMPOSITION OF COMPRESSED ILLUMINATING GAS WITH PRESSURE AS IT ISSUES FROM THE COMPRESSION CYLINDER.—BY HENRY JERMAIN MAUDE CREIGHTON, DR. SC., F. C. S., Assistant Professor of Chemistry, Swarthmore College, Swarthmore, Penna., U. S. A.

(Read 9 February, 1920)

In the course of another investigation it became necessary for the writer to employ an illuminating gas containing 5 to 6 per cent. of carbon dioxide. As the content of carbon dioxide in the gas of the laboratory was about one-half this amount, a cylinder of purified carburetted water-gas under a pressure of approximately 300 pounds per square inch was obtained through the courtesy of a neighboring gas company. An analysis of the gas prior to compression gave the following results:

	Per cent.
Carbon dioxide	5.5
Illuminants	13.7
Oxygen	0.9
Carbon monoxide	26.9
Hydrogen	35.0
Methane	12.4
Ethane.	1.3
Nitrogen	4.3
	<hr/>
	•100.0

Before employing the gas in the investigation to which reference has been made, the carbon dioxide content in a sample taken from the compression cylinder was determined. To the writer's surprise this amounted to only 3.5 per cent. The same result was obtained with several other samples. On thinking the matter over, the conclusion was reached that the low carbon dioxide content in the samples of gas taken from the compression cylinder must be due to differences in the rates of diffusion of the components of the gas through the very small orifice of the compression cylinder; the heavier carbon dioxide diffusing less rapidly than the lighter hydrogen and methane. In order to substantiate this conclusion, and to ascertain the manner in which the composition of the diffused gas altered with the diffusing pressure, analyses were made of samples of gas taken from the compression cylinder as the pressure therein was gradually decreased.

The reducing valve of the compression cylinder was connected with a gas-meter, which in turn was attached to a bunsen burner. Samples of the gas were obtained for analysis from a three-way tube placed between the cylinder and the gas-meter. The gas was allowed to flow from the cylinder at a constant rate of 120 liters per hour. Since each division on the scale of the main pressure gauge of the cylinder corresponded to 62.5 pounds per square inch, samples of gas were taken for analysis after each reduction in pressure of this amount. Determinations of carbon dioxide, illuminants, oxygen and carbon monoxide were made in the usual way. Owing to lack of apparatus for the separation and estimation of hydrogen, methane and ethane, these components could not be separately determined. In Table I are recorded the amounts of carbon dioxide, illuminants, oxygen, carbon monoxide and the mixed lighter components ($H_2 + CH_4 + C_2H_2 + N_2$) found in samples of gas taken at various cylinder pressures. These results are shown graphically in Figure 1.

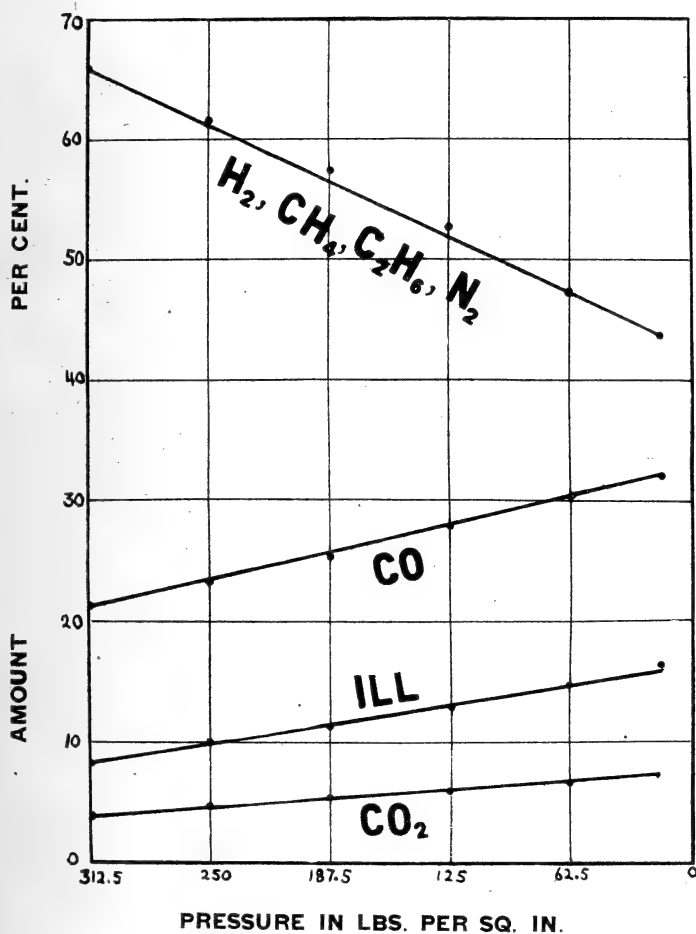
TABLE I

Component	Percentage Composition						Average
	At a pressure (in lbs. per sq. in.) of :						
	312.5	250	187.5	125	62.5	15	
CO ₂	3.8	4.5	5.2	5.8	6.4	6.9	5.4
Ill.	8.2	9.8	11.2	12.9	14.8	16.6	12.2
O ₂	1.0	0.8	0.9	0.7	0.8	0.7	0.8
CO	21.2	23.2	25.3	28.1	30.5	32.0	26.7
H ₆ + CH ₄ + C ₂ H ₈ + N ₂	65.8	61.7	57.4	52.5	47.5	43.8	55.0

It will be observed from the results contained in Table I, that the averages of carbon dioxide, oxygen and carbon monoxide agree closely with the amounts of these components contained in the gas before compression. The low average for illuminants and the consequent high average for the residue of hydrogen, methane, ethane and nitrogen are quite possibly due

to condensation of a small portion of the heavy hydrocarbons while the gas was under the higher pressures. From the data contained in the table and from the curves it will be seen that, in accordance with Graham's diffusion law, with decrease in pressure the percentage increase for carbon monoxide is less than that for carbon dioxide, and this in turn is less than that of illuminants.

FIG. 1.





ACCIDENTAL OCCURRENCE OF THE PYGMY SPERM WHALE (*Kogia breviceps*) ON THE COAST OF NOVA SCOTIA: AN EXTENSION OF ITS KNOWN RANGE; WITH REMARKS ON THE PROBABILITY OF THE FORMER PRESENCE IN THESE WATERS OF THE TRUE SPERM WHALE (*Physeter macrocephalus*).—BY HARRY PIERS, Curator of the Provincial Museum, Halifax, N. S.

(Read 9 February, 1920.)

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Any information regarding the rarer Cetaceans of Nova Scotia is of value, as we have little positive data regarding their occurrence here. This more particularly applies to the True Whales (*Balaenidae*) and the Sperm Whales (*Physeteridae*). Our Dolphins (*Delphinidae*) are somewhat better known, but they also deserve attention. Whenever possible, advantage should be taken of any opportunity to examine and definitely determine the specific name of specimens stranded or otherwise taken on our coast.

PYGMY SPERM WHALE (*K. breviceps*).

Specimen taken at Herring Cove, Halifax County, N. S.—On 17th January, 1920, when Jeremiah Gray and other men were cutting out ice to prevent it carrying away the wharves, in case of storm, in Herring Cove (west long. 63° 33', north lat. 44° 34'), a small inlet on the western side of the outer part of Halifax Harbour, Halifax County, Nova Scotia, they chanced to come upon the body of a small-sized whale. The animal was eight and a half feet long, and it was lying dead just beneath the ice. The spot where it was found was about one hundred yards from the head of the narrow cove, and about twenty yards from the western shore,

and the depth of water there is ten feet at low tide. The species had never before been seen by any of the many fishermen and other sea-going men of the locality.

The winter of 1919-20 had been a most abnormally cold one, with the temperature about zero (Fah.) for quite long periods, and cold weather had set in very early in the season, about the middle of December. Herring Cove had frozen on 12th January, and the ice, which was five inches thick, extended from the head of the inlet, nearly down to the government wharf which is on the western shore three hundred yards from the head. No doubt the whale on coming into the small inlet, had got under the ice, and not happening to retrace its way, had drowned beneath the strong covering, as it was unable to reach the surface to breathe. The black skin was abraded off the top of the head, doubtless from the frantic efforts of the suffocating animal to force its way through the ice.

A newspaper reference to the capture of the whale caused me to telephone for the head, fins and flukes to be sent to the Provincial Museum, where they arrived on 22nd January. On examination of these essential parts, I was much surprised to find that the species was the Pygmy Sperm Whale (*Kogia breviceps*, Blainville), a nearly adult female, belonging to the family *Physeteridae* and related to the huge Sperm Whale or Cachalot (*Physeter macrocephalus*, Linn.) from which it differs distinctly, apart from the great inequality in size. An adult Pygmy Sperm Whale grows to a length of only fifteen feet or so, while a male true Sperm Whale may be nearly seventy feet in length. After making careful drawings and measurements, the flesh was removed from the head; and the skull, dorsal and left pectoral fins, and the flukes were preserved (Museum Accession No. 4829).

Specimens taken on the United States coast.—The Pygmy Sperm Whale, which is generally a rare species, has never before been reported from Canadian waters, and previous to 1904 there was no reference to its occurrence on the adjoining New England coast from Maine south to Connecticut (*vide* Glover M. Allen's List of Mammalia: Fauna of New England; Occas. Papers Bost. Soc. Nat. Hist., vol. 7, Bost., 1904; and F. B. Sumner's Catalogue of Marine Fauna of Woods Hole and Vicinity, Bull. U. S. Bur. of Fisheries, vol. 31, Wash., 1913). Since 1904 it has been twice taken in Massachusetts waters, and a life-size cast and the skeleton of one of these are in the museum of the Boston Society

of Natural History (*vide* letter of G. M. Allen, 30 Jan., 1920.) That is the most northern range on this coast hitherto known. Gerrit S. Miller did not include it in his Preliminary List of New York Mammals (Bull. N. Y. State Mus., 6, no. 29, Albany, 1899), but a large female, containing a foetus, was stranded at Long Beach, Long Island, N. Y., on 28th February 1914, and the skeleton is now in the American Museum of Natural History, New York, (*vide* Bull. Am. Mus. Nat. Hist., 38, pp. 7-72, N. Y., 1918), and a second specimen was taken at South Beach, Staten Island, N. Y., on 1 March 1920 and is now in the same museum (*vide* letter of F. A. Lucas). It has been taken several times on the coast of New Jersey, viz., (a) female, 8½ ft. long, containing a foetus, collected at the Life Saving Station, Spring Lake, lat. 40° 10', on 27th April, 1883, now in U. S. National Museum, acc. 13060, (type of *Kogia goodei* True)*; (b) adult female, 10ft. 6 in. long, collected at Barnegat City, 24th Oct. 1885, now in U. S. National Museum, acc. 16706; and (c) young male, collected at Loveladies, 25th Oct. 1885, now in U. S. National Museum, acc. 16705. In Virginia, a male was washed up on the beach during a storm at Dam Neck Mills, south of Virginia Beach, in Feb., 1887 (U. S. Nat. Museum, acc. 22559); and in North Carolina, a male, 7 ft. 10 in. long, was taken at Kitty Hawk, 5th Jan. 1885 (U. S. Nat. Museum, acc. 15560).† It is not commonly found about the West Indies.

Range.—Its general range is in tropical regions, and its occurrence beyond is more or less accidental. True (1885) gives the geographic habitat as "temperate and tropical seas". Lydekker (Guide to Whales, Porpoises and Dolphins in Brit. Museum, p. 26, Lond., 1909) says it is very widely distributed, having been met with in the Indian and Southern Oceans, and in the North Pacific, but it does not occur in British waters. It is apparently more common in the southern hemisphere; it or very closely related forms having been taken a number of times in the New Zealand seas, and also once on the coast of California. Some of these specimens have been described as different species, but G. M. Allen thinks that probably they should all be included under

*This specimen is figured by True, Rept. U. S. Fish Com. for 1883, pl. 8, fig. 22, Wash., 1885.

†I am indebted to W. deC. Ravenal and Wm. Palmer, of the U. S. National Museum, Wash., for particulars regarding the specimens taken on the coasts of New Jersey, Virginia, and North Carolina.

breviceps. F. E. Beddard (Mammalia, p. 367, Camb. Nat. History, Lond., 1902) allows two species, if the accounts of their osteology are to be depended upon, namely *Kogia breviceps* and *Kogia (Callignathus) simus*, the latter from the coast of India. The former is said to have 13 pairs of ribs, no teeth in upper jaw and 14 or 15 in each ramus of lower jaw; and the latter, 14 pairs of ribs, 2 teeth in upper jaw and 9 in each ramus of lower jaw. *K. floweri*, a Californian form, whose teeth are particularly long and recurved, and *K. pottsi* from New Zealand, have been described as distinct forms, but further investigation will probably indicate that they are merely varietal forms of *K. breviceps*.

We thus see that the accidental occurrence of *Kogia breviceps* in north latitude $44^{\circ} 34'$, close to Halifax, Nova Scotia, is remarkable and worthy of note, because it considerably extends the range and also adds another mammal to the casual members of our marine fauna.

How the present individual came on our coast.—To account for its occurrence here, we must surmise that it had come from tropical regions, to the southern coast of the United States or the vicinity of the West Indies, and thence northward in the warm waters of the Gulf Stream, and straying westward out of that current, had come by chance to our cold shore in the middle of an unusually severe winter, there to die, not directly as a result of the low temperature of the water, but because of the ice which gave it no opportunity to come to the surface to breathe. That it coasted up along the shore of the United States, is a less probable hypothesis. The number of female specimens containing fetuses which have been taken in northern waters, suggests the possibility that their unusual visits are in some way associated with the breeding season.

Description.—As the species is seldom met with, a description of the present specimen will be of some interest. The accompanying plate illustrates the external characters of the entire animal, and also depicts all aspects of the cranium, which latter is complete in all its parts. These drawings have been made with considerable care, so as to be accurate in all particulars, especially as regards the skull. Gray, in his Catalogue of Seals and Whales in the British Museum, second edition, Lond., 1866, p. 216, gives figures of the dorsal and lateral views of a skull and a lateral view of a lower jaw, reproduced from those of M. de Blainville of 1838, and these figures have generally been

copied as depicting the cranial characters of this species. De Blainville's drawing, made from a single skull from Cape of Good Hope, in the Paris Museum, was not a perfect one, as the original lacked some rather important parts, particularly about the maxillary notches, and the details of the parts present are not very well represented. The ear-bones (periotic and tympanic bones) were without doubt missing in de Blainville's specimen, as is very often the case with cetacean skulls; and these extremely interesting and important bones have never, I believe, before been figured, and they are difficult to describe without drawings. Both the right and left ear-bones are complete in our specimen and the left one is figured, in opposite side-views, on my plate, on a scale very slightly less than one-third natural size. (See plate, page 101.)

Diagnosis.—The species may be readily recognized by its protruding snout, bluntish head which is not truncate, the toothless upper jaw, and toothed lower jaw having about fourteen sharp teeth on each side, blowhole on the top of the head, and the presence of a dorsal fin. The skull may be known by its unsymmetrical and concave dorsal region, and the dental characters referred to.

External characters.—Head contained six times in total length. Snout projecting beyond the mouth; the face only very slightly flattened below extremity of snout. Eye much above angle of mouth. Blowhole on top of head and very slightly to left side; shape crescentic. Lower jaws very narrow in front; no teeth in upper jaw; fourteen on each side of lower jaw. Dorsal fin present, small and low, falcate. Pectorals rather small, pointed. Peduncle of tail strongly keeled above and below.

Viewed dorsally, the snout is moderately sharp; viewed laterally, the front of the head is blunt, the mouth projecting 3 inches beyond a vertical line from the anterior end of the mouth. Mouth very narrow, capable of being opened to an angle of about 70°; tongue short, its extremity only coming to 3 ins. of end of mandible; transverse diameter of throat, 2.15 ins. Eye set rather high, about midway between dorsal and ventral lines, and slightly posterior to the posterior end of mouth opening. The single external orifice of the blowhole is on the upper part of the head (not anteriorly as in *Physeter*), and it is somewhat crescentic, with the convexity to the front, and its transverse length is 2.45

ins. It is situated not quite on the medial dorsal line, the centre being .52 inch to the left of that line. It is closed, in a valve-like manner, by the posterior wall coming in contact with the anterior wall, so as to exclude water; and surrounding it is a white, very tough, muscular or cartilaginous fibre. The outer vestibule of the blowhole is of the length of the external opening, and is 1.75 ins. deep. It is coloured black within. From the left end of this vestibule is a small tubular passage (spiracle) penetrating nearly perpendicularly into the head, to the left superior naris, which could be explored with a probe to a depth of 5.50 ins. from the surface of the head. A right-hand passage could not be located with the probe, but the man who removed the flesh said he found also a right-hand smaller opening leading into the head, and connecting with the right-hand superior naris. Although I searched for the small external ear-opening, I was not quite sure I had located it, but the position of the well-developed ear-bones (tympano-periotic bones) of the skull, shows that the external orifice must be about 2.50 ins. behind and a little below the level of the eye, where I had detected a minute pore or opening.

Dorsal fin composed of adipose tissue, without any osseous connection with the vertebrae; low, falcate; its basal length contained about 13 times in length of animal, its height about $2\frac{1}{4}$ times in its basal length. Pectoral fins short, moderately broad, and somewhat pointed; their anterior margin a little less than $\frac{1}{8}$ th as long as length of animal, their greatest breadth contained $2\frac{1}{2}$ times in their greatest length. Flukes moderately excavated on the hind margin, and with a small acute notch in the centre of that margin; the distance from tip to tip, 1.84 times the greatest length of the pectoral.

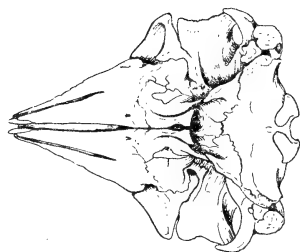
The weight of the animal was reported to have been about 400 pounds. The "blubber" or fatty tissue was concentrated on the outside of the animal, immediately beneath the skin, and at the back of the neck it formed a layer 1.40 ins. thick, white in colour and it readily furnished a clear yellowish oil of high quality. The flesh was of a very dark red colour, entirely free from fat; and on being eaten after frying, was exceedingly tender, but in my opinion was somewhat too strong in flavour to be very palatable, although two gentlemen who also tried it considered it excellent. It has no oily or fishy flavour; but does not possess the very fine edible qualities of a steak from the back of the Harbour Porpoise



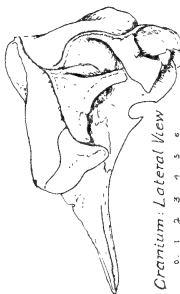
Feet
1 2 3 4 5 6 7 8 9 10 11 12
Scale
1 2 3 Feet



Cranium: Dorsal View



Cranium: Ventral View



Cranium: Lateral View

Cranium Scale of Inches
0 1 2 3 4 5



Cranium: Posterior View



Left Petrotic and Tympanic Bones



H. Piers del.



Mandible: Lateral View

PYGMY SPERM WHALE, *Kogia breviceps* (Blainville).
Female, 8 ft. 6 ins. long. Taken at Herring Cove, near Halifax, N.S., Nova Scotia; 17 Jan., 1920.

(*P. communis*), which is particularly savoury, resembling somewhat a very tender moosesteak.

Colour.—Upper parts and sides, including interior of blowhole, outside of pectoral and upper side of flukes, black. Underparts whitish or greyish white. Inside of mouth pink; teeth white.

Skull.—As crania of the Pygmy Sperm Whale are seldom met with in collections, particularly in America, a rather full description of that part of the animal will probably be of interest. The skull of *Kogia* and that of the allied *Physeter* are thought to be perhaps the most modified from the ordinary type of cranium in the whole mammalian class. The skull of the present specimen is short, broad, and with the exception of the mandible, massive; and crests are strongly developed. The rostrum, from in front of the maxillary notches, forms about an equilateral triangle, the lateral margins being somewhat concave anteriorly and slightly convex posteriorly. The length of rostrum to a line drawn between the bases of the deep maxillary notches, is contained in the total length of skull, 1.91 times (52.3 per cent.). The greatest breadth of the skull (post-orbitally) is contained in the total length, 1.23 times (81.6 per cent.).

Viewed dorsally the skull is very strongly asymmetrical along the median posterior region, whereas the lateral outlines are symmetrical. The lack of symmetry is chiefly noticeable in (a) the median crest, (b) the intermaxillae, and (c) the nares. We find the prominent median crest strongly twisted to the left as it proceeds from the vertex anteriorly until it reaches the nares; the left intermaxilla anteriorly is widened, and the right one narrowed, whereas posteriorly the right one is widened and passes back to the vertex and the left one is short. The left naris is very much the larger one, its diameter being about $3\frac{1}{3}$ rd times that of the right one; and although the septum is mesially situated, the disproportion between the magnitude of the two openings give the nares the appearance of being towards the left side. A prominent horse-shoe shaped crest proceeds from one maxillary notch, around to the vertex, and thence to the other notch.

Examined more minutely, the two intermaxillae show great lack of symmetry, more particularly in the posterior parts. Both widen posteriorly, but in different degrees, and the right one is much the longer. The right one is anteriorly the narrower, but from the small right naris backward it is considerably widened,

is twisted, and joins the median crest on its lefthand edge, and extends to within a short distance of the supraoccipital-frontal crest. The left premaxilla is wider than the right one before the nares, and seemingly terminates at the posterior margin of the large left naris, but the suture is somewhat difficult to discern.

The maxillae are narrow anteriorly, but widen and thicken greatly at the maxillary notch, which latter is narrow but penetrates very deeply (4.3 cm. deep). Transversely the maxillae begin to be strongly concave here. Just posterior to the notches, the maxillae are very greatly thickened, and thence rise in a strongly elevated lateral crest which passes in a curve, as before mentioned, back to where they and the supraoccipital form a sharp, curved transverse crest near the vertex. This curved crest thus forms a "horse-shoe" enclosing a concave basin, in which formerly was situated the loose connective tissue containing the supply of spermaceti. Another very prominent crest arises at the vertex (where it joins the transverse crest) and passes forward, being twisted to the left, S-wise, and finally is lost at the posterior margin of the large left naris. Whether this crest is formed by the right margin of the left maxilla, or by it in conjunction with the left nasal, I am unable to say with certainty, as only the median suture between the maxillae can be traced. At any rate, the nasals are difficult to precisely locate, unless the sutures should subsequently open up.

The frontal is entirely covered by the maxillae posteriorly; but the supraorbital process of the frontal is massive and well developed. The body of the malar is massive, and has a strong postero-inferior process, just anterior to the orbit. The zygomatic process of the squamosal is prominent, but shows no unusual thickening. The greatest breadth of the skull is in this region. The supraoccipital bone rises almost vertically from the foramen magnum, to meet the posterior margins of the maxillae (and the covered frontals) and then joins in forming the transverse crest.

Viewed ventrally, the skull is symmetrical. The intermaxillae show for a short distance only (3.5 cm.) at tip of rostrum. The maxillae are convex in cross-section, and have two narrow but deep channels towards their lateral margins; these grooves representing the obsolete tooth-row. The palatines

show, in a rather small area, just anterior to the pterygoids. The pterygoids meet mesially for about half their length anteriorly, then are separated by an elongate-ovate space, and again approximate posteriorly at their crests. Their posterior free margins or crests are straight and set somewhat obliquely to a transverse line. From the sides of the inferior nares, two sharp, much elevated crests proceed backward, divergingly, to the region of the auditory meatus, as is usual in allied animals.

The interesting periotic and tympanic bones, or "ear-bones," are dark coloured in the exterior member, which measures 5.8 cm. in vertical length, 3.4 cm. in antero-posterior breadth, and 2.1 cm. in greatest thickness at the superior end; while the interior inflated, shell-like member (the tympanic) is ivory-coloured, rather thin, and beautifully and rather intricately convoluted in a manner which cannot be easily described. Both of the ear-bones have been preserved and are complete. The accompanying plate contains opposite sideviews of the left ear-bone, on a scale slightly less than one-third the natural size. As before mentioned, I believe the ear-bone of this species has never before been figured.

The mandibles (lower jaws) are very thin and delicate, and have little depth at the anterior half where the tooth-row is situated, but are moderately deep at the posterior ends. The symphysis is long (6.5 cm.); and posterior to it the rami gradually, and then strongly, separate from each other. The tooth-rows are thus approximately parallel, and only 1.5 cm. apart, for about half the length of the rows. The length of the tooth-row is contained in the mandibular length, $2\frac{1}{2}$ times; the distance between the condyles is about $\frac{5}{6}$ ths of the same length; and the depth from the coronoid process to the angle, is contained $2\frac{2}{3}$ rd times in that length, while the depth at the tooth-row is only $\frac{1}{6}$ th of the length of the tooth-row.

Teeth.—Upper jaw toothless; teeth in lower jaw, 14 on each side; dental formula, $\frac{0-0}{14-14}$. The teeth are not very firmly attached in the alveolae, and therefore may be slightly moved about. They are rather small, slender, conical, decidedly sharp, very slightly curved inward at the tip and also toward the embedded basal part. Their total length, midway in the row, is .73 inch; the diameter at the basal part is .12 in., and the crown projects out of the gum .35 in. They are separated, from centre to centre, .36 in.

External measurements.—The following general measurements, with the exception of those of the fins and flukes, were made by Mr. Gray, and without doubt follow the contour of the body in some of the dimensions. They also have been reduced to percentages of the total length of the animal.

	Inches	Cm.	Percent.
Total length, snout to notch in posterior margin of tail	102.00	259.3	100.0
Circumference of body	70.00	178.0	68.6
Snout to anterior end of dorsal fin	48.00	122.0	47.1
Snout to anterior insertion of pectoral fin	24.00	61.0	23.5
Dorsal fin, basal length	7.50	19.0	7.4
Dorsal fin, vertical height	3.40	8.6	3.3
Pectoral fin, greatest length, (anterior margin)	12.50	31.8	12.3
Pectoral fin, greatest breadth	5.10	13.0	5.0
Pectoral fin, basal length	5.75	14.6	5.6
Flukes, from tip to tip	23.00	58.5	22.5

The following measurements (chords) were very carefully made by myself from the head. They have also been reduced to percentages of the total length of the head.

	Inches	Cm	Percent
Length of head, snout to basal condyle	17.25	43.8	100.0
Diameter of head, from eye to eye	13.75	35.0	79.7
Snout to anterior margin of eye	13.80	35.1	80.0
Snout to anterior margin of blowhole	10.40	26.5	60.3
Snout to anterior end of mouth (above)	7.50	19.1	43.5
Snout to posterior end of mouth	13.00	33.1	75.3
Mouth opening, length measured on upper jaw	6.25	15.9	36.2
Mouth opening, length measured on lower jaw	6.00	15.2	34.8
Upper jaw, breadth near anterior end	1.50	3.8	8.7
Lower jaw, breadth near anterior end	1.00	2.5	5.8
Lower jaw, width midway in length	2.50	6.3	14.8
Lower jaw, width at posterior end of mouth opening	4.25	10.8	24.6
Blowhole, transverse length	2.45	6.2	14.2
Blowhole, antero-posterior width	.85	2.2	5.0
Centre of blowhole to centre of right eye	10.38	26.3	60.2
Centre of blowhole to centre of left eye	9.35	23.7	54.2
Right hand extremity of blowhole to centre of right eye	9.16	23.2	53.1
Right hand extremity of blowhole to centre of left eye	8.12	20.6	47.1
That is, the blowhole is situated to left of medial dorsal line	.52	1.3	3.0
Eye, length	1.00	2.5	5.8
Eye is 7.20 ins. (18.3 cm.) above, and about 2 ins. (5 cm.) posterior to the posterior angle of mouth			
Blubber, thickness at back of head	1.40	3.6	
Skin, thickness	.02	.05	

Cranial Measurements.—The following are the measurements of the skull, with the same reduced to percentages of the total length of the skull:

	Cm. Percent.	
Total length, from centre of line joining surface of occipital condyles to extremity of rostrum	34.8	100.0
Length of rostrum to line joining bases of maxillary notches	18.2	52.3
Length of rostrum to outer end of maxillary notches	15.2	43.7
Breadth of rostrum at base of maxillary notches	12.8	36.9
Greatest breadth of rostrum in front of maxillary notches	16.5	47.4
Depth of maxillary notches	4.3	12.4
Breadth of rostrum midway in its length	10.6	30.5
Breadth of right intermaxilla at middle of rostrum	1.7	4.9
Breadth of left intermaxilla at middle of rostrum	2.0	5.8
Breadth of both intermaxillae between their exterior edges, at middle of rostrum	6.5	18.7
Greatest breadth between intermaxillae posteriorly	8.2	23.6
Length of right tooth-groove	12.0	34.5
Length of left tooth-groove	10.9	31.3
Posterior end of right tooth-groove to base of maxillary notch	6.1	17.5
Posterior end of left tooth-groove to base of maxillary notch	7.3	21.0
Extremity of rostrum to anterior margin of right superior naris	20.2	58.0
Extremity of rostrum to anterior margin of left superior naris	18.6	53.4
Extremity of rostrum to end of pterygoid crest, mesially	21.5	61.8
Extremity of rostrum to end of pterygoid crest, laterally	22.1	63.5
Anteorbital breadth (between processes of malar)	27.4	78.7
Breadth between orbits	28.0	80.5
Breadth between squamosals (postorbital breadth):— greatest breadth of skull	28.4	81.6
Breadth between hinder margins of temporal fossae	18.0	51.7
Greatest breadth of occipital bone	23.9	68.7
Temporal fossa, greatest length	8.1	23.2
Temporal fossa, greatest breadth	5.2	14.9
Length of mandible	30.6	88.0
Length of symphysis of mandible	6.5	18.7
Length of tooth-row of mandible, right	11.8	34.0
Length of tooth-row of mandible, left	12.0	34.5
Depth between angle and coronoid process	8.3	24.0
Distance apart of upper edges of mandible, halfway in length	6.7	19.2
Diameter of right naris, antero-posteriorly	1.3	3.7
Diameter of right naris, laterally	1.1	3.2
Diameter of left naris, antero-posteriorly	4.0	11.5
Diameter of left naris, laterally	3.2	9.2
Diameter of largest tooth	24	7

Micmac Indian tradition of a blunt-headed whale.—On showing the head of this whale to a very well-informed Micmac Indian, Jeremiah Lone-cloud (*alias* Bartlett), he examined it carefully and stated that he had never seen the species before, but from descriptions given him by two very old Indians, Noel Jeddore, who is now dead, and Soolian (William) Bill, he felt sure it must be what was known by the Indian name *Ded'-men-ak-paj'-jet*, a name which means "blunt-head" fish. Noel Jeddore had been born at Melrose, St. Mary's, N. S., and

died about 25 years ago, aged 84 years; and old Soolian Bill had formerly belonged to Cape Breton Island and now lives on the Truro reservation, aged about 97 years.*

Noel Jeddore told Lone-cloud that about fifty years ago, say about 1870, he and other Indians were encamped on a small island called by the Indians *Up-quaw'-we-kunk* or "Bark-camp Island", off West Medford, on the south side of the entrance to Pereau Creek, in Minas Basin, Kings Co., N. S., when a school of about a dozen cetaceans became stranded on a mudflat there. The Indians examined them and got some of the flesh for food, and he said that the cooked back-fin was much relished by them. The animals were about 12 or 15 feet long, coloured black, and had a small dorsel-fin. Such cetaceans had never before or afterwards been seen by Jeddore and his companions, but he had heard from other older Indians that such animals had occurred years previously, and that they had been called by the Micmacs *Ded-men-ak-paj-jet*, from the blunt appearance of their head. This word resembles an old Micmac name applied to another rare cetacean which once occurred here, *Ded-men-ak-part*, which means "head cut off squarely," not merely "blunt-head." Further reference will be made to this latter animal when I come to write of the true Sperm Whale. (See page 112).

Old Soolian Bill very recently told Lone-cloud that he also had seen the cetacean which they call *Ded-men-ak-paj-jet*, and said it occurred in the same season when the others were taken off West Medford. About fifty years or more ago, he states, a number of sea animals of the kind seen at West Medford came ashore in a "gut" of water near the Indian reservation at Whycocomagh, St. Patrick's Channel, Bras d'Or Lakes, Cape Breton Island.† Bill and other Indians examin-

*The well-known and respected Micmac Indian, William Prosper, usually known as "Soolian Bill," died at the Truro Reservation on 3rd April, 1923, and it was claimed that he was one hundred and one years of age. The name Soolian is evidently a corruption of the French name Guillaume (William). He was born at Bay of Islands, Newfoundland, and came to Whycocomagh, Cape Breton, about 1848, removing to Dartmouth, opposite Halifax, in 1860, the year the Prince of Wales was in Nova Scotia. About 1888 he finally went to Truro. If he came to Halifax in 1860, as stated, the date of the occurrence of the above-mentioned cetacean at Whycocomagh must have been prior to that year.

†It may be mentioned that at the same time that these cetaceans came ashore at Whycocomagh, two very large whales (Micmac *Boot-up*, name for any large whale) came in at the same place and one ran ashore and was killed by the Indians with a scythe-blade on the end of a pole. Soolian Bill saw it, and he said it made a great commotion with its very long fins, so that one had to be careful in approaching it. It was towed to Arichat, Rich. Co., and there the blubber was removed. It is not reported whether it had a back-fin or not. Probably it was the Humpback Whale (*Megaptera nodosa*).

ed and cut up the animals and obtained much oil from the blubber; and one which they opened contained a foetus. They also called the animal *Ded-men-ak-paj-jet*, agreed that it was the same species as that taken in Minas Basin, and that it was extremely rare, but that old Indians told them it had been taken years before. It also had a dorsal-fin.

The rare animals described by Jeddore and Soolian Bill were not Black-fish (*Globicephala melas*) which is the only other distinctly "blunt-headed" cetacean it might be confused with, and which is a common species, well known to the Indians as *Sarb'-a-dee'-meekw*, which means "John Fish," but why so-called is not known. The Bottlenose Dolphin (*Tursiops truncatus*) has too much beak to be particularly designated as the "blunt-head." We are therefore led to conclude that these very rare cetaceans referred to by our Micmacs, must have been the Pygmy Sperm Whale (*K. breviceps*), which answers the Indians' rough description in having a blunt head, a dorsal-fin, and being about twelve or fifteen feet long, black in colour, and very rare in these waters. The presence of the dorsal-fin shows it was not the true Sperm Whale, for which apparently our Indians also have a descriptive name. This is a related subject to which we will now refer.

SPERM WHALE (*P. macrocephalus*).

Did the True Sperm Whale formerly occur on the Nova Scotian coast?—Whether the huge Sperm Whale or Cachalot (*Physeter macrocephalus* Linn.) ever occurred on our Nova Scotian coast, accidentally or otherwise, in the early years when its range was very much less restricted than now, is a point which is not definitely settled in my mind, although from evidence at hand I am very decidedly of the opinion that it must have. In a paper like this, dealing with a related species, it may not be altogether out of place to give a little attention to the subject.

Many years ago the true Sperm Whale was reported all along the New England coast as far north as Casco Bay, Maine, where it is recorded that one was stranded in 1668.* Casco

*G. M. Allen, List of Mammalia of N. E., Occ. Papers Bost. Soc. Nat. Hist. 7, pt. 3, Bost. 1904; and G. Brown Goode, Fisheries and Fishing Industries of U. S., sec. 1, page 9, Wash., 1884.

Bay is in the same latitude as southern Nova Scotia. In August 1761, one was killed in lat. $45^{\circ} 54'$, long. $53^{\circ} 57'$, which is off the southern Newfoundland coast and 275 miles due east of Scaterie, Cape Breton; and in 1766 another was seen near George's Bank, which is to the south of Nova Scotia and a little beyond its limits.* These are merely recorded occurrences, but of course there are many others which did not happen to be noted. The most northern grounds which they regularly frequented some thirty-five years ago, were off Cape Hatteras. Glover M. Allen, in a recent letter to me, writes that "the Sperm Whale (*P. macrocephalus*) must occasionally reach Nova Scotian waters, although I do not recall at this moment a definite record. It is taken once in a while off the Newfoundland coast at the whaling stations." The manager of a Newfoundland whaling station told Prof. E. E. Prince that their whaling vessels had twice taken Sperm Whales off the Cape Breton coast and towards Newfoundland.

While this paper is in type, I find a thrilling account of the capture of thirty Sperm Whales in the harbor of Keels (lat. $48^{\circ} 32'$) in Bonavista Bay, almost eighty miles north-northwest of St. John's, Newfoundland, in the early part of August, 1922. The account, by Thomas Kelly, appeared in the "Canadian Fishermen," Gardenville, P.Q., Oct. 1922, vol. 9, p. 221, and it describes a remarkable instance of daring among the Newfoundland fishermen. A motor-boat from Keels, when a few miles off land, encountered about seventy large whales, which the fishermen mistook for Blackfish or "Pot-heads" (*G. melas*) and which they accordingly undertook to drive to the shore. Some seven motorboats took part in this operation, three boats on either side, and one behind making much noise with its exhaust. The large animals went shorewards like a flock of sheep, and made no commotion even when a boat happened to run upon one of their backs.

When, however, the whales found that they were entrapped in the cliff-surrounded harbour of Keels, they began to fight terrifically, and the men, in some twenty or thirty boats, commenced to kill them. Hatchets, axes, knives, and guns were used in efforts to subdue the monsters. Forty-eight bullets are said to have been fired into the head of one of them. Men were to be seen on the backs of the animals, chopping with axes. No

*G. B. Goode, loc. cit., page 8.

men were killed, although a small boat was smashed to pieces. Hawasers and steel cables were made fast to some of the whales but were snapped with great ease. Some of the infuriated animals dashed themselves against the cliffs and so died. In all thirty were killed.

The services of a man who for ten years had been foreman of a "whale factory" were secured, and he identified them as Sperm Whales. Wells were made in the heads of the monsters, and a great quantity of pure oil was dipped therefrom; from one to four puncheons of fluid being taken from each head.

Additional particulars of this very remarkable occurrence were forwarded to me on 19th January, 1923, by the Department of Mines and Fisheries of Newfoundland, which had obtained the information from a most reliable source, Mr. J. F. Murphy of St. John's, who had visited Keels and examined the dead animals. Mr. Murphy says that they were undoubtedly Sperm Whales, the most valuable of the cetaceans, and he enclosed a carefully prepared drawing with measurements made by himself, which proves conclusively that their specific identity had been correctly determined. They were all young males, and varied in length from 45 to 48 feet, whereas an adult male sometimes measures as much as 80 feet. The one he measured particularly was 47 feet in greatest length from the anterior end of the truncated snout to the tip of the flukes or tail. From the snout to the posterior angle of the mouth it measured 12 feet; and from the angle of the mouth to the extremity of the flukes, 35 feet. The vertical depth of the head, from the dorsal region to the mouth, was 7 feet; and the distance between the two ends of the flukes was from 9 to 11 feet. It had 22 teeth in each side of the lower jaw. Three of the teeth, forwarded by Mr. Murphy to the Provincial Museum, are definitely the teeth of the true Sperm Whale.

He says that about forty-four of the whales were driven ashore at Keels, the harbour of which is of circular form, everywhere surrounded by vertical cliffs except at the entrance. The fishermen killed thirty of them, using guns, axes, mowing-scythes, and sharpened sticks employed as lances. In some cases stout pieces of timber with pointed ends were driven into the blow-hole of the animals, which maddened them, and so furious did they become (probably because of the difficulty experienced in their efforts to breathe) that they dashed themselves against the cliffs,

thus driving home the stakes which had protruded from the front of their heads like a vessel's jib-boom. These animals died suddenly. Later the others, which were wounded, went into a "flurry" and thrashed themselves to death against the cliffs and isolated rocks.

Knowing that the valuable substance called ambergris is obtained from the alimentary canal of this species of whale, Mr. Murphy went to Keels and had the stomach of one of the carcasses opened. In it was found about a bushel of the beaks of small and large species of squid, the favourite food of this whale, the beaks being of all sizes from a quarter up to one-and-a-half inch in length, each with a curious growth on the larger end, somewhat like a cock's comb. No ambergris was found. It is known that beaks of the cuttle-fish or squid are frequently found embedded in ambergris sent to market, and Mr. Murphy believes that the irritating action of these pointed beaks on the animal's stomach causes the formation of that material. Other carcasses were then opened, but also without finding real ambergris. One, however, contained a growth about six or eight inches long and about six inches in diameter, having holes in it like those of a sponge, and varying in color from pale green to dark brown. This was examined by the government analyst, Mr. Davis, who reported that it was not ambergris. It is possible that it may have been an early stage in the formation of that substance, and that the animals were too young to have developed it perfectly.

The fishermen were unfortunately entirely unprepared for such an unexpected and unprecedented occurrence, and had no knowledge of the great value of such whales, and they destroyed them, with but little if any profit to themselves. Two or three groups of men dipped from four to five hundred gallons of pure, clear sperm-oil from the head of each whale. Very little of it, however, was saved, as they had no facilities for properly handling it owing to the huge carcasses and the workers being exposed to the wash of the surf.

Sperm whales usually swim in herds or schools, or else singly. The schools consist of (a) females and their young, with one or two adult males, and (b) young and half-grown males. Full-grown males go singly in search of food. The Keels school was one of the herds of half-grown males, which had no doubt come northeastward in the Gulf Stream, and then by chance had

wandered westward to the Newfoundland coast, in pursuit of the great multitude of squid which are its principal food.

When we consider the northern range of the Sperm Whale in early years, before the persistent industry of whalers had nearly exterminated it in the northernmost waters of the Atlantic, it cannot be possible that that species did not also occur in our intervening waters, at least casually if not somewhat regularly, a couple of hundred years ago and probably much later.

In the absence of definite records, we naturally turn for some light on the subject to our Micmac Indians who are keen observers of natural objects which come to their attention, and whose ability for handing down information traditionally, in the absence of written records, is truly remarkable.

Our Indians inform me that very old men of their tribe have an ancient tradition, handed down by their fathers, of a very rare cetacean which the later men have never seen. To this animal they gave the very characteristic descriptive name of *Ded'-men-ak'-part*, which signifies "head cut off sharply or squarely," or as my informant, Lone-cloud, further explained it, "Just the same as if you cut the head off squarely in front." Such a name could surely only have been applied to the Sperm Whale, whose large and remarkably blunt head is so characteristic a feature that it would instantly have attracted the sharp eyes of our natives on viewing a casually stranded individual, and who, in their well-known fashion, would have included this character in framing a descriptive name which has been handed down to later generations. It must be noted that this name is to be distinguished from the related one, *Ded-men-ak-paj-jet*, to which reference has previously been made, which means an animal with merely a blunt head, and which I believe designated the Pygmy Sperm Whale, as a dorsal-fin is specifically referred to as being present. The same Indian knew the two names and applied them to different animals. The name *Ded-men-ak'-part* was known through tradition to both old Soolian Bill, formerly of Cape Breton Island, and to Nole Jeddore, before mentioned, so that the animal probably occurred both about that island as well as off the mainland of Nova Scotia. Unfortunately the tradition does not seem to mention whether the dorsal fin was absent in this very blunt-headed cetacean; for if it did, the identification would be as about complete as could be desired.

Conclusion.—Taking into consideration all the evidence, I think we may quite safely conclude that *Ded-men-ak-part* of the Micmacs was the true Sperm Whale and that it formerly occurred to some extent at least in our Nova Scotian waters.

Teeth of this cetacean should be searched for in some of the Indian shell-heaps or kitchen-middens in Nova Scotia, as the natives would no doubt preserve such relics of an unusual marine animal if one had been stranded on our coast.

In the DesBrisay collection of Indian remains collected in Lunenburg County, N. S., now in the Provincial Museum, is a small tooth, a good deal corroded, which has a general resemblance to one from an exceedingly young Sperm Whale.* But it may even prove on further examination to be merely a young Bear's canine tooth, which somewhat closely resembles the former. I do not believe it belonged to a Black-fish (*Globicephala melas*) or any other cetacean I happen to be familiar with, and it is decidedly not a tooth of a Pygmy Sperm Whale. It measures 1.87 in. (47.5 mm.) in greatest length; its diameter, midway in length, is .48 in. (12.5 mm.); it projected out of the gum .57 in. (14.5 mm.), and the conical free end (crown) is very strongly incurved;

The Provincial Museum possesses several Sperm Whale teeth, but they have all been brought by whalers from the southern whaling rounds.

Provincial Museum, Halifax, N. S.,
9th February, 1920.

*The smallest Sperm Whale on record, taken on the New England coast, was one 16 feet long, taken near New Bedford in 1842.

A CONVENIENT FORM OF BURETTE FOR EXACT GAS ANALYSIS.

BY HENRY JERMAIN MAUDE CREIGHTON, D. Sc., Assistant Professor of Chemistry, Swarthmore College, Swarthmore, Penn., U. S. A.

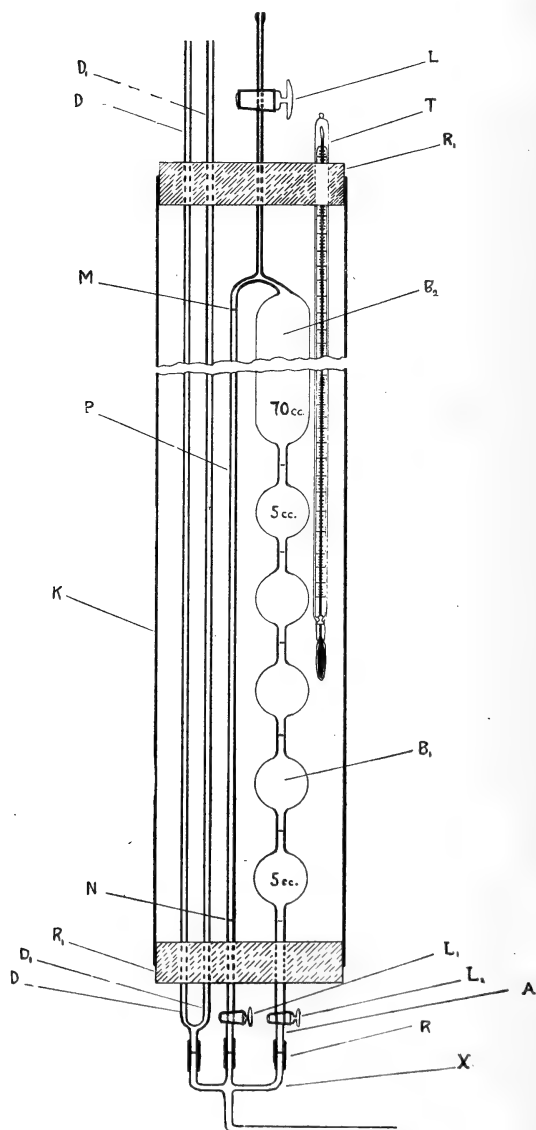
(Read 10 May, 1920)

A large number of gas burettes for various kinds of analysis is described in the chemical literature and in the catalogues of chemical apparatus. With most of these burettes, which have a volume of 100 or 150 cc. and are graduated to read to 0.1 or 0.2 cc., it is not possible to measure differences in volume with an accuracy of more than 0.1 or 0.2 per cent., an accuracy sufficient for many purposes. Since in some kinds of work a greater accuracy is highly desirable, the writer proposes to describe a type of burette which has he designed and had specially made for determining differences in gaseous volumes with a accuracy of about 0.02 per cent.

This burette (Figure 1) consists of a measuring tube, P, and a reservoir-tube, A, joined together at the top by a capillary tube to which is connected a stop-cock, L, and closed at the bottom ends by the stop-cocks, L1 and L2. The tube A is made up of five small bulbs, B1, each holding 5.00 cc. between the marks on the constricted portions on either side of the bulb, and a large bulb, B2. The volume of the bulb B2 and the capillary tube between the stop-cock L and the mark M on the upper portion of the tube P is 70 cc. The arm P, consisting of a thick-walled tube with an internal diameter of three millimeters, has a volume of 5.00 cc. between the marks M and N. This portion of P is graduated throughout its entire length and each division reads 0.01 cc.

As small variations in temperature during analysis produce changes in the volume of gas amounting to several hundredths of a cubic centimeters, the burette is enclosed in a water-jacket, K, along with a thermometer, T, reading to tenths of a tenth of a degree. The water-jacket has a diameter of 85, cm., and is closed at the ends by the rubber stoppers R1. There are also enclosed in the water-jacket two leveling tubes, D1 and D2, which have approximately the same diameter as the small arm, P, of the burette. These two tubes are joined together at the bottom outside the water-jacket. Each of the rubber stoppers, R1, has a small opening (not shown in the Figure)

FIG. 1.



through which the water-jacket be filled or emptied, or through which water at a constant temperature can be circulated.

The lower end of D1, and D2, and the lower ends of the small and large arms of the burette are joined by heavy rubber tubing to the three-arm tube X, the horizontal portion of which is joined by two meters of rubber pressure tubing to a reservoir containing mercury.

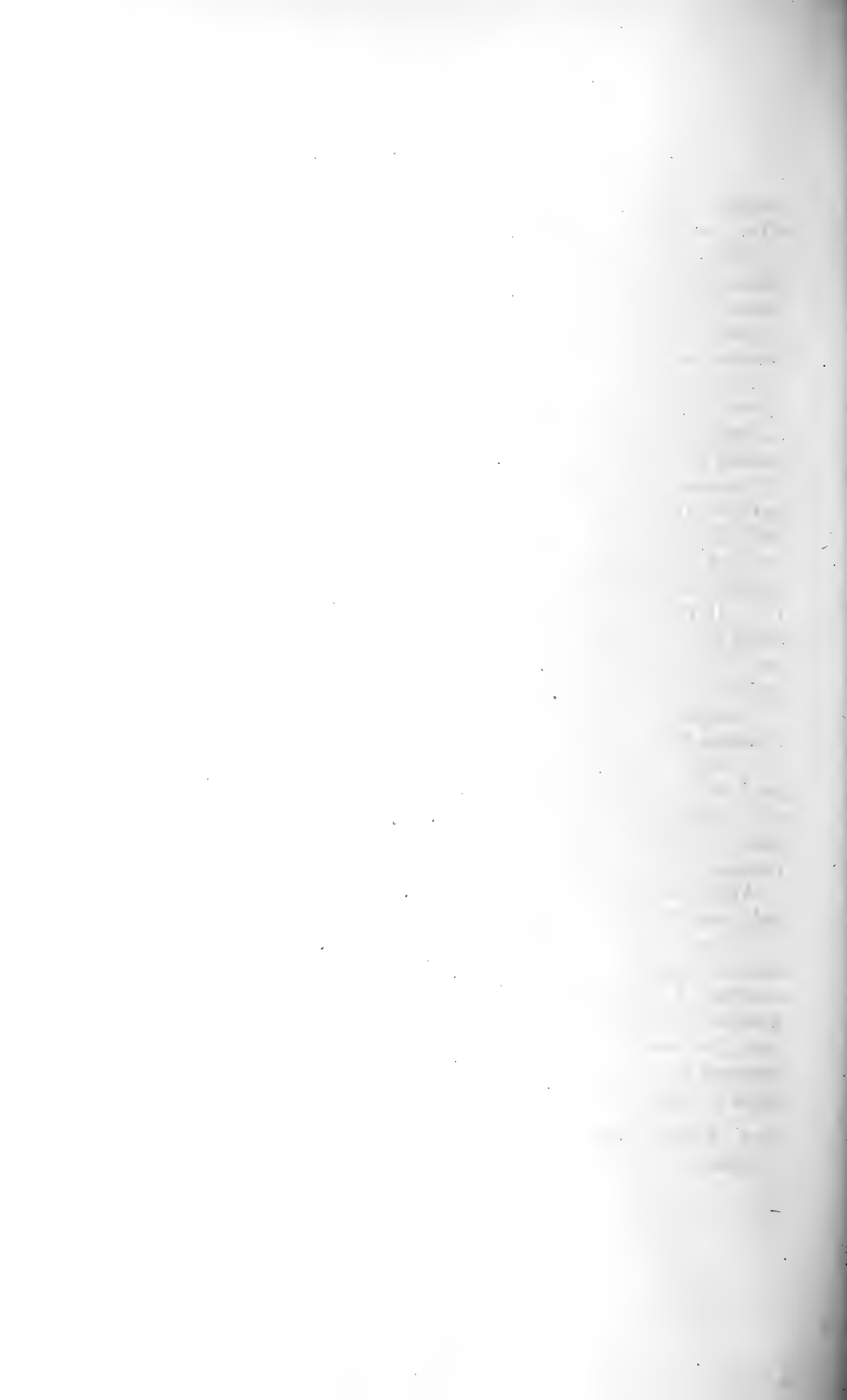
The absorption pipettes are connected to the upper end of the burette in the usual way. The rubber connections are, however, enclosed in mercury to prevent leaks. It is also advisable to employ for L a stop-cock with a mercury seal.

In order to measure a given volume of gas enclosed in the burette, the stop-cock L1 is closed, the stop-cock L2 opened and the reservoir containing the confining liquid raised or lowered, until the level of mercury in the larger arm of the burette is brought to one of the marks between two of the bulbs B1. If the volume of gas is between 95 and 100 cc., the first small bulb is filled with mercury; if the volume is between 90 and 95 cc. the first two small bulbs are filled with mercury and so on. The stop-cock L2 is then closed and the stop-cock L1 opened, and the fraction of 5 cc. contained in P measured by bringing the mercury in P, D1 and D2 to the same level. This is readily accomplished by getting the mercury meniscus in each of the three tubes in a line, one behind the other. When this is done, the stop cock L1 is closed and the volume of gas read. It is necessary, of course, to make corrections for changes temperature and pressure which occur during analysis.

With this particular burette it is only possible to measure gas volumes which are more than 70 cc. and not more than 100 cc.

The writer has used this burette to determine the carbon dioxide, oxygen and carbon monoxide in more than one hundred samples of air, in laboratories and large industrial plants. In a number of instances where small quantities (0.02 to 0.04 per cent.) of carbon monoxide were found present in the air, subsequent investigation showed its presence to be due to small leaks in the illuminating gas lines and connections.

The Chemical Laboratory,
March 2nd, 1920.



NOTES ON THE SPRING BIRD MIGRATION OF 1914 AT ANTIGONISH, NOVA SCOTIA.—BY HARRISON F. LEWIS, Quebec, P. Q.

(Read 10 May, 1920)

The County of Antigonish lies in the eastern part of the Nova Scotian peninsula on the south shore of St. George's Bay, an arm of the Gulf of St. Lawrence. With the exception of two weeks in late December and early January, the period from August 25, 1913, to June 27, 1914, was spent by me in the county, my residence being in the small town of Antigonish, the county town.

In the spring of 1914, a record of the migration was made for the Biological Survey of the United States Department of Agriculture. The time spent in making observations for this record consisted chiefly of the early morning hours every day with additional time later in the day on Saturdays and Sundays. There was then no thought of publishing the results of these observations, but, in view of the scarcity of published records of the birds of Antigonish County, to which my attention has since been called, and of the improbability of additional similar work on my part in the county, it may be advisable to make readily accessible such data as were obtained. As far as I know, or have been able to find out, the only previous publications relating directly to the birds of this county are the four brief ones hereinafter quoted in their respective appropriate connections.

The coming of spring is normally later in Antigonish County than it is in western and central Nova Scotia. This is due to the large fields of heavy ice which form in winter in the Gulf of St. Lawrence, and which, in melting, cool the winds which blow from them across the land to the southward. The spring of 1914 was said by the inhabitants of the county to be somewhat later than the average. Snow in the woods was knee-deep on April 25. About two inches of snow fell on the night of May 1-2. On May 15 the shore of St. George's Bay was found to be strewn with great blocks of ice, some of them three or four feet thick, while large fields of ice could be seen floating in the bay. Heavy frosts, accompanied by the formation of thin ice on dishes of water left out-of-doors, occurred once or twice in early June. These conditions are the cause of the lateness of the arrival of many species of birds. Where I have any especial

reason to think that the date of arrival as observed for a particular species is, or may be, inaccurate, this fact has been indicated in this paper.

Of the species herein recorded from Antigonish County, the following are stated by Chapman ('Handbook of Birds of Eastern North America' revised edition, 1912, p. 30) to be characteristic of the Alleghanian fauna: Black-billed Cuckoo, Kingbird, Bobolink, Chipping Sparrow, Blue-headed Vireo, Catbird, and White-breasted Nuthatch.

Taking one species, such as the Fox Sparrow, for instance, the following items are recorded concerning it in this paper in the order here stated: serial number, scientific name, vernacular name, date first seen, number of individuals observed on the date first seen, date next seen, date of becoming common, estimated degree of abundance, date last seen, remarks. So far as they are applicable or were noted, similar items are recorded in similar order for each of the other species in the list of migrants. The nomenclature used is that of the 1910 edition of the 'A. O. U. Check-List'. Terms indicating degrees of abundance are used in the following relative order: rare, uncommon, not common, tolerably common, common, very common, abundant, very abundant. A species is not recorded as breeding unless its nest was seen by me in the county; other species were observed as summer residents, presumably breeding, unless otherwise stated.

1. *Sterna hirundo*. Common Tern.—First seen, May 21 (13); next seen, May 23; common, May 21; a very common summer resident; breeds. On June 13th I visited Mahoney's Beach, at the western side of the entrance to Antigonish Harbor, and there found about 50 pairs of this species nesting. The beach on which the nests were placed is a long, narrow ridge of sand, forming part of the mainland, and separating the waters of Antigonish Harbor from those of St. George's Bay. Much of it is covered with the usual low herbage of our sand beaches; other parts are bare white sand. I counted 49 nests containing eggs; of which 23 were hollowed in the sand, while the 26 others were hollowed in dry bunches or windrows of seaweed which had been thrown above ordinary high-tide mark by the storms of winter. On June 21 I again visited this colony, when I found but one nest containing eggs. As a search revealed no trace of the other eggs or of any young Terns, it seems probable that

the colony, so easily accessible, had been raided by human enemies in the interval between my two visits.

2. *Anas rubripes*.—Black Duck.—First seen, March 28 (2); next seen, April 10; apparently uncommon.

3. *Branta canadensis canadensis*.—Canada Goose.—First seen, March 19 (10); next seen, March 29 common, March 19; common; last seen, May 7; a transient only. Apparently these birds pause in their migration for some time at this point, until conditions farther north are favorable for a resumption of their movement to their breeding grounds. During April the great shallow areas in Antigonish Harbor form the feeding-ground of large flocks of Canada Geese, containing several thousand individuals.

4. *Botaurus lentiginosus*.—American Bittern.—First seen, May 10 (1); next seen, May 13; common, May 21; common.

5. *Ardea herodias herodias*.—Great Blue Heron.—First seen, April 27 (1); next seen, April 30; not common.

6. *Gallinago delicata*.—Wilson's Snipe.—First seen, April 20 (2); next seen, April 22; not common. When passing through Antigonish County in 1917, I saw a single bird of this species on the upper South River on April 10.

7. *Actitis macularia*.—Spotted Sandpiper.—First seen, May 13 (2); next seen, May 15; common, May 17; common.

8. *Aegialitis semipalmata*.—Semipalmated Plover.—First seen, May 15 (5); next seen, May 23; not common. Probably not an accurate record of first arrival. The only place where I observed this species was Mahoney's Beach.

9. *Aegialitis meloda*.—Piping Plover.—First seen, May 23 (2); next seen, June 13; rare. Perhaps not an accurate record of first arrival. The only place where I observed this species was Mahoney's Beach, at the mouth of Antigonish Harbor. When I visited the Beach on May 15, none were seen, but 2 were there at the time of my next visit, on May 23. The greatest number of individuals seen in one day was 4, seen June 13.

10. *Pandion haliaetus carolinensis*.—Osprey.—First seen May 9 (1); next seen, May 17; uncommon.

11. *Ceryle alcyon*.—Belted Kingfisher.—First seen, April 30 (1); next seen, May 2; common, May 5; tolerably common.

12. *Colaptes auratus luteus*.—Northern Flicker.—First seen April 20 (1); next seen April 26; common, April 28; common.

13. *Chordeiles virginianus virginianus*.—Nighthawk.—First seen, May 29 (1); next seen, May 30; uncommon.

14. *Chaetura pelagica*.—Chimney Swift.—First seen, May 22 (2); next seen, May 23; common, May 25; common. (This record published in "A Cooperative Study of Bird Migration" by Charles H. Rogers, 'Bird-Lore', Vol. XVI, No. 4, p. 272, July-August, 1914.)

15. *Archilochus colubris*.—Ruby-throated Hummingbird.—First seen, May 31 (1); next seen, June 1; common, June 1; very common.

16. *Tyrannus tyrannus*.—Kingbird.—First seen, May 21 (2); next seen, May 22; common, May 22; common.

17. *Nuttallornis borealis*.—Olive-sided Flycatcher.—First seen, May 25 (1); next seen, May 27; uncommon.

19. *Myiochanes virens*.—Wood Pewee.—First seen, May 30 (1); next seen, May 31; uncommon.

19. *Empidonax flaviventris*.—Yellow-bellied Flycatcher.—First seen, May 25 (3); next seen, May 30; common, May 30; common.

20. *Empidonax trailli alnorum*.—Alder Flycatcher.—First seen, May 28 (1); next seen, May 30; common, June 3; common.

21. *Empidonax minimus*.—Least Flycatcher.—First seen May 19 (1); next seen, May 20; common, May 21; common.

22. *Otocoris alpestris* subsp.?—Prairie (?) Horned Lark.—First seen, March 24 (1); next seen, March 25; common, March 27; tolerably common; last seen, April 18. Although Horned Larks were observed as transients only, all my observations of them in the field led me to believe them to be Prairie Horned Larks, *O. a. praticola*. It is possible that their breeding-grounds were in some of the great pasture areas in Antigonish County, some miles from Antigonish town.

23. *Dolichonyx oryzivorus*.—Bobolink.—First seen, May 16 (1); next seen, May 18; common, May 21; common.

24. *Agelaius phoeniceus phoeniceus*.—Red-winged Blackbird.—First seen, May 2 (1); next seen, May 23; rare summer resident; breeds. Probably not an accurate record of first arrival. An account of my discovery of a nest and eggs of this species in a swamp near the mouth of Antigonish Harbor has been published in 'The Auk', Vol. XXXI, No. 4, pp. 537-538, October, 1914.

25. *Euphagus carolinus*.—Rusty Blackbird.—First seen, April 8 (5); next seen, April 9; common, April 11; tolerably common transient rare in summer.

26. *Quiscalus quiscula aeneus*.—Bronzed Grackle.—First seen, April 7 (1); next seen, April 8; common, April 12; common.

27. *Carpodacus purpureus purpureus*.—Purple Finch.—First seen, May (1); next seen, May 10; common, May 11; common. Although individuals of this species not infrequently pass the winter in Nova Scotia, my notes lead me to believe that migrants usually do not arrive until late April or early May.

28. *Astragalinus tristis tristis*.—Goldfinch.—First seen, May 26 (1); next seen, May 27; common, May 28; very common. Individuals of this species also are known to winter in Nova Scotia, but it would appear from my notes that the migrants generally arrive in the latter half of May.

29. *Poocetes gramineus gramineus*.—Vesper Sparrow.—First seen April 28 (3); next seen, April 29; common, April 28; tolerably common.

30. *Passerculus sandwichensis savanna*.—Savannah Sparrow.—First seen, April 26 (2); next seen, April 27; common, April 30; common.

31. *Passerherbulus nelsoni subvirgatus*.—Acadian Sharp-tailed Sparrow.—First seen, June, 3 (1); next seen, June 4; uncommon.

32. *Zonotrichia albicollis*.—White-throated Sparrow.—First seen, May 8 (1); next seen, May 9; common, May 9; abundant summer resident; breeds. It will be observed that this species arrived on the night of May 7-8, and that the Fox Sparrow departed on the same night. At Halifax, N. S., in 1918, the Fox Sparrow departed and the White-throated Sparrow arrived on the night of April 28-29. In both of these instances the Fox Sparrow had been a very common transient. The feeding habits of these two species appear to be essentially similar, as they both feed largely on the ground among bushes, and it is possible that this fact, in combination with the comparative scarcity of food in early spring, when much of the ground is still snow-covered, may have aided in causing these species to be thus complementary in Nova Scotia at that season.

33. *Spizella passerina passerina*.—Chipping Sparrow.—First seen, May 9 (2); next seen, May 10; common, May 15; very common summer resident; breeds.

34. *Junco hyemalis hyemalis*.—Slate-colored Junco.—First seen, March 24 (1); next seen, April 4; common, April 7; abundant summer resident; breeds.

35. *Melospiza melodia melodia*.—Song Sparrow.—First seen, April 4 (1); next seen, April 5; common, April 7; very common. First song heard April 5, when, of 4 birds seen, one only was heard to sing.

36. *Melospiza lincolni lincolni*.—Lincoln's Sparrow.—First seen, May 19 (1); next seen, May 20; common, May 20; tolerably common.

37. *Melospiza georgiana*.—Swamp Sparrow.—First seen, April 30 (1); next seen, May 5; common, May 9; tolerably common.

38. *Passerella iliaca iliaca*.—Fox Sparrow.—First seen, April 13 (4); next seen, April 14; common, April 14; very common; last seen, May 7; a transient migrant only. Antigonish appears to lie on an important highway of migration for this species. Probably most of these birds were on their way to Newfoundland.

39. *Zamelodia ludoviciana*.—Rose-breasted Grosbeak.—First seen, May 25 (3); next seen, May 27; common, May 27; common. Nowhere else has it been my good fortune to find this species as common as I found it about Antigonish.

40. *Petrochelidon lunifrons lunifrons*.—Cliff Swallow.—First seen, May 22 (25); next seen, May 23; common, May 22; common. The accuracy of this date of arrival seems questionable, although I watched carefully for this species.

41. *Hirundo erythrogaster*.—Barn Swallow.—First seen, May 15 (9); next seen, May 16; common, May 15; common summer resident; breeds.

42. *Iridoprocne bicolor*.—Tree Swallow.—First seen, April 26 (1); next seen, April 28; common, May 15; common.

43. *Riparia riparia*.—Bank Swallow.—First seen, May 23 (5); next seen, May 30; common, May 30; locally common summer resident; breeds. Found only about earthen banks along the shore of St. George's Bay. As I did not visit that shore between May 15 and May 23, the above date of arrival may not be accurate.

44. *Bombycilla cedrorum*.—Cedar Waxwing.—First seen, May 27 (9); next seen, June 5; irregular in occurrence.

45. *Vireosylva olivacea*.—Red-eyed Vireo. First seen, May 25 (4); next seen, May 27; common, May 27; common.

46. *Lanivireo solitarius*.—Blue-headed Vireo.—First seen, May 20 (1); next seen, May 21; common, May 23; tolerably common.

47. *Mniotilta varia*.—Black-and-White Warbler.—First seen, May 16 (1); next seen, May 18; common, May 20; common.

48. *Vermivora ruficapilla ruficapilla*.—Nashville Warbler.—First seen, May 25 (1); next seen, May 30; rare.

49. *Compsothlypis americana usneae*.—Northern Parula, Warbler.—First seen, May 16 (1); next seen, May 18; common, May 20; 21 very common.

50. *Dendroica aestiva aestiva*.—Yellow Warbler.—First seen May 19 (1); next seen, May 20; common, May 20; very common

51. *Dendroica caerulescens caerulescens*.—Black-throated Blue Warbler.—First seen, May 23 (1); next seen, May 24; uncommon.

52. *Dendroica coronata*.—Myrtle Warbler.—First seen, April 21 (2); next seen, April 22; common, May 5; common.

53. *Dendroica magnolia*.—Magnolia Warbler.—First seen, May 14 (1); next seen, May 16; common, May 21; very abundant. I consider this to be the most abundant summer resident bird about Antigonish. If my experience in a number of other localities in Nova Scotia is typical, I should judge this to be the most abundant Warbler, perhaps the most abundant summer resident bird, in the province as a whole.

54. *Dendroica pensylvanica*.—Chestnut-sided Warbler.—First seen, May 24 (1); next seen, May 25; rare.

55. *Dendroica striata*.—Black-poll Warbler.—First seen, May 25 (3); next seen May 27; common, May 28; common. Although I have no reason to suppose that this species is a summer resident in Antigonish County, I can now find no record of the date of its departure for the summer.

56. *Dendroica fusca*.—Blackburnian Warbler.—First seen, May 27 (1); next seen, May 30; not common.

57. *Dendroica virens*.—Black-throated Green Warbler.—First seen, May 9 (1); next seen, May 10; common, May 17; abundant. The second Warbler in point of abundance.

58. *Dendroicapalmarum hypochrysea*.—Yellow Palm Warbler.—First seen, April 24 (1); next seen, May 9; common, May 9; very common transient; probably not generally common as a summer resident. I have no similar migration record for this or any like species. In comparison with records of arrival in

other parts of Nova Scotia in other years, April 24 appears to be a normal date of arrival for this bird. The individual seen on that date at Antigonish was clearly observed in the bare branches of an apple tree. On the days immediately following I sought faithfully for this Warbler, for I always tried to obtain dates of second observations as close to arrival dates as possible, and, as day after day went by without my seeing anything more of the species, I hunted for it the more persistently. Yet it was not observed again until fifteen days after the first individual was seen; then, on May 9, it suddenly became common.

59. *Seiurus aurocapillus*.—Oven-bird.—First seen, May 18 (1); next seen, May 20; common, May 20; very common.

60. *Seiurus noveboracensis*.—Water-Thrush.—First seen, May 17 (2); next seen, May 19; common, May 20; common transient; not common summer resident. In most of western Nova Scotia this bird appears to be uncommon or rare. About Antigonish I found it, by comparison, rather more common as a summer resident and very much more common as a transient visitor in spring. In summer it is confined to deep, swampy woods, where there is stagnant water, but in the migration its cheerful song sounds not only in such places, but along every brook and river and body of fresh water, large or small. Apparently Antigonish is on the main highway followed by individuals of this species which breed in Cape Breton and Newfoundland, and, perhaps, eastern Labrador. The comparative rarity of the species in western Nova Scotia would seem to indicate that these eastern migrants enter the province by way of the Isthmus of Chignecto.

61. *Oporornis philadelphia*.—Mourning Warbler.—First seen May 30 (1); next seen, May 31; not common. More common than I have found it elsewhere in Nova Scotia.

62. *Geothlypis trichas trichas*.—Maryland Yellow-throat.—First seen, May 21 (4); next seen, May 22; common, May 22; common.

63. *Wilsonia pusilla pusilla*.—Wilson's Warbler.—First seen, May 25 (3); next seen, May 28; uncommon; last seen, May 28; observed as a transient only.

64. *Wilsonia canadensis*.—Canadian Warbler.—First seen, May 25 (1); next seen, May 27; common, May 29; common.

65. *Setophaga ruticilla*.—Redstart.—First seen, May 21 (2); next seen, May 22; common, May 22; very common.

66. *Anthus rubescens*—American Pipit.—My only observation of this species at Antigonish was of one bird seen in a plowed field on May 20.

67. *Dumetella carolinensis*.—Catbird.—First seen, May 28 (6); next seen, May 30; common, May 28; common.

68. *Nannus hiemalis hiemalis*—Winter Wren.—First seen, May 8 (1); next seen, May 9; not common.

69. *Regulus calendula calendula*.—Ruby-crowned Kinglet.—First seen, April 27 (1); next seen, April 30; common, May 2; common.

70. *Hylocichala guttata pallasii*.—Hermit Thrush.—First seen May 1 (1); next seen, May 8, common.

71. *Planesticus migratorius migratorius*.—Robin.—First seen, March 26 (1); next seen, March 28, common; April 9, very common. (This record published in "A Cooperative Study of Bird Migration," by Charles H. Rogers, 'Bird Lore', Vol. XVI, No. 3, p. 182, May-June, 1914).

Unfortunately regular notes on birds not observed as spring migrants were not made. From occasional notes on rare or unusual occurrences, or events of particular interest, however, the following additional data concerning the birds of Antigonish County may be supplied. Certain familiar species, which were presumably common or abundant, must, from lack of record, here be conspicuous by their absence.

72. *Harelda hyemalis*.—Old Squaw.—One male observed on St George's Bay, not far from the entrance to Antigonish Harbor, January 31, 1914.

73. *Bonasa umbellus togata*.—Canada Ruffed Grouse.—A not common permanent resident.

74. *Coccyzus erythrophthalmia*—Black-billed Cuckoo.—The familiar, characteristic notes of a Cuckoo distinctly heard June 20, 1914, doubtless emanated from one of this species.

75. *Sphyrapicus varius varius*.—Yellow-bellied Sapsucker.—A pair observed September 27, 1913.

76. *Cyanocitta cristata cristata*.—Blue Jay.—My only records are of several observations of the species during January and February, 1914.

77. *Perisoreus canadensis canadensis*.—Canada Jay.—Recorded in September and October, 1913, and January, 1914.

78. *Corvus brachyrhynchos brachyrhynchos*.—Crow.—Common permanent resident.

79. *Pinicola enucleator leucura*.—Pine Grosbeak.—My only observation was of a flock of 8 or 9, containing no adult males, seen near Maryvale, April 18, 1914.

80. *Passer domesticus domesticus*.—English Sparrow.—A common permanent resident in Antigonish town.

81. *Loxia curvirostra minor*.—American Crossbill.—A small flock, containing several adult males, was observed at close range, May 2, 1914, near Mahoney's Beach. The birds were feeding in low spruce trees and on the ground. A few Crossbills were seen during the winter, but the species was not determined.

82. *Acanthis linaria linaria*.—Redpoll.—Seen in small flocks during the winter and early spring.

83. *Plectrophenax nivalis nivalis*.—Snow Bunting.—Recorded as seen occasionally in small flocks from January 11 to March 7.

84. *Spizella monticola monticola*.—Tree Sparrow.—My only observation was of a single individual, March 7, 1914.

85.—*Lanius borealis*.—Northern Shrike.—Single individuals observed several times in winter and early spring. Heard singing in January and February.

86. *Certhia familiaris americana*.—Brown Creeper.—Several observed in song in heavy deciduous woods in late April.

87. *Sitta carolinensis carolinensis*.—White-breasted Nuthatch.—Observed several times in autumn and winter, principally on shade trees in Antigonish town.

88. *Sitta canadensis*.—Red-breasted Nuthatch.—My only observation of this species was of a pair seen January 24, 1914. (See "A Problem in Food-Supply and Distribution" "Bird-Lore," Vol. XVI, No. 2, p. 113, March-April, 1914.)

89. *Penthestes atricapillus*.—Chickadee.—Common; particularly noticeable in winter.

90. *Penthestes hudsonicus littoralis*.—Acadian Chickadee.—Common permanent resident in coniferous woods.

91. *Regulus satrapa satrapa*.—Golden-crowned Kinglet.—Noted in February, 1914. Doubtless observed, but not recorded, in other seasons also.

THE PHENOLOGY OF NOVA SCOTIA, 1919.—BY A. H. MACKAY, LL.D., Halifax.

These observations were made by the school children of the Province of Nova Scotia as a part of the Nature Study work prescribed. The pupils report by bringing into the school-room the flowering or other specimens when first observed, for authoritative determination by the teacher, who generally credits the first finder by placing the name and the observation on the honor roll section of the blackboard for the day. The teacher, after testing the correctness of the observation, marks it on the schedule with which every teacher is provided—a copy of which is sent in to the Inspector with the school returns at the end of June and January.

The following tables are compiled from 140 of the best schedules out of the 400 sent in. The selections were made and compiled under the direction of Mr. H. R. Shinner, B. A., and Miss Gladys MacLeod, of the Education Department.

The schedules for each year are carefully bound up in a large annual volume, which is placed in the Provincial Museum and Science Library, where they can be used by students of climate, etc. The compilers of the phenochrons of the different belts, slopes or regions, have been rural science teachers who have most distinguished themselves as instructors. They were selected for the purpose on the recommendation of the Director of rural science education. The sheets from which the provincial phenochrons are calculated are also bound in annual folio volumes for ease of consultation and preservation.

The Province is divided into its main climate slopes or regions not always coterminous with the boundaries of counties. Slopes, especially those to the coast, are subdivided into belts, such as (a) the coast belt, (b) the low inland belt, and (c) the high inland belt, as below:

No.	Regions or Slopes.	Belts.
I.	Yarmouth and Digby Counties,	(a) Coast, (b) Low Inlands, (c) High Inlands.
II.	Shelburne, Queens & Lunenburg Co's,	" " "
III.	Annapolis and Kings Counties,	(a) South Mts., (b) Annapolis Valley, (c) Cornwallis Valley, (d) North Mts.
IV.	Hants and Colchester Counties,	(a) Coast, (b) Low Inlands, (c) High Inlands.
V.	Halifax and Guysboro Counties,	" " " "
VI.a.	Cobequid Slope (to the south),	" " " "
VI b.	Chignecto Slope (to the northwest),	" " " "
VII.	Northumberland Straits Slope (to the n'h),	" " " "
VIII.	Richmond & Cape Breton Co's,	" " " "
IX.	Bras d'Or Slope (to the southeast),	" " " "
X.	Inverness Slope (to Gulf, N. W.),	" " " "

The ten regions are indicated on the outline map on page 134.

158	167	164	203	205	200	203	43.	"	"	fruit ripe.	212	162	167	211	216	179	167	210	....
159	162	166	165	170	170	166	44.	Rhinanthus	Crista-galli.	....	171	164	170	171	175	170	168	171	....
160	163	160	163	166	155	168	45.	Rubus	villosus.	....	169	164	170	211	246	245	246	254	167
161	164	169	165	171	171	170	235	46.	"	fruit ripe.	240	168	163	160	177	173	171	171	132
162	163	160	167	171	171	170	168	47.	Sarracenia	purpurea.	162	168	163	160	177	173	171	171	170
163	164	165	171	171	171	170	168	48.	Brunella	vulgaris.	171	172	173	176	177	174	174	173	176
164	169	165	171	171	171	170	168	49.	Rosa	lucida.	174	169	169	170	177	174	174	171	172
165	172	172	170	171	171	170	168	50.	Leonodon	autumnale.	172	169	169	170	177	174	174	171	172
166	163	164	165	171	171	170	168	51.	Linaria	vulgaris.	170	169	169	170	177	174	174	171	172
167	163	164	165	171	171	170	168	52.	Trees	appear green.	147	144	144	142	144	144	159	163	145
168	162	169	175	155	133	139	138	53.	Ribes	rufum (cultivated)	150	142	145	149	145	152	153	150	150
169	136	134	133	133	140	140	144	54.	"	"	206	147	153	143	207	153	196	215	152
170	135	140	143	137	150	152	148	55.	R. nigrum	(cultivated)	150	147	153	143	207	153	196	215	152
171	137	146	138	143	145	148	147	56.	"	fruit ripe.	208	143	152	148	152	161	200	219	158
172	137	143	143	146	156	152	146	57.	Prunus	Cerasus.	153	143	152	148	152	161	200	219	158
173	143	143	146	156	152	146	151	58.	"	fruit ripe.	213	149	156	149	153	158	161	154	163
174	143	145	146	156	155	150	157	59.	Prunus	domestica.	156	149	156	149	153	158	161	154	163
175	144	149	145	147	151	151	157	60.	Pyrus	Malus.	156	152	155	152	153	156	158	154	161
176	144	149	145	147	151	151	157	61.	Syringa	vulgaris.	163	161	164	159	161	164	158	162	168
177	154	158	156	158	160	158	159	62.	Trifolium	repens.	167	164	168	165	165	168	169	167	169
178	157	161	160	159	162	162	161	63.	Trifolium	pratense.	166	162	168	162	163	163	168	167	171
179	150	153	156	156	159	161	162	64.	Phleum	pratense.	167	160	161	170	173	167	171	168	168
180	152	153	156	156	159	161	162	65.	Solanum	tuberosum.	179	160	161	170	173	167	171	168	168
181	177	177	174	174	174	174	174	66.	"	"	179	160	161	170	173	167	171	168	168
182	109	110	117	119	123	120	126	67.	Ploughing	first of season.	128	114	134	130	129	130	134	126	130
183	130	130	133	138	132	132	135	68.	Sowing.	....	139	139	137	141	145	138	139	146	135
184	123	127	135	137	141	137	138	69.	Potato-planting.	....	142	130	133	146	148	146	149	142	142
185	129	125	131	135	135	128	122	70.	Sheep-shearing.	....	137	139	132	139	142	143	148	137	126
186	....	....	....	....	214	213	217	71.	Hay-cutting.	....	219	....	....	....	216	218	225	....	....
187	....	....	....	....	246	246	246	72.	Grain-cutting.	....	253	....	....	....	251	256	252	251	257
188	....	....	....	....	260	252	265	73a.	Potato-digging.	....	271	....	....	....	271	257	273	275	281
189	....	....	....	....	260	256	261	73b.	Opening of rivers.	....	271	....	....	....	271	257	273	275	281
190	....	....	....	....	260	256	261	74a.	Opening of lakes.	....	271	....	....	....	271	257	273	275	281
191	....	....	....	....	260	256	261	74b.	Last snow to whiten ground	....	271	....	....	....	271	257	273	275	281
192	....	....	....	....	260	256	261	74c.	to fly in air.	....	271	....	....	....	271	257	273	275	281
193	....	....	....	....	260	256	261	74d.	Last Spring frost—hard.	....	271	....	....	....	271	257	273	275	281
194	....	....	....	....	260	256	261	74e.	—hoar.	....	271	....	....	....	271	257	273	275	281
195	....	....	....	....	260	256	261	74f.	Water in streams—high.	....	271	....	....	....	271	257	273	275	281
196	....	....	....	....	260	256	261	74g.	—low.	....	271	....	....	....	271	257	273	275	281
197	....	....	....	....	260	256	261	74h.	First autumn frost, hoar.	....	271	....	....	....	271	257	273	275	281
198	....	....	....	....	260	256	261	74i.	First autumn frost, hoar.	....	271	....	....	....	271	257	273	275	281
199	....	....	....	....	260	256	261	74j.	First snow to fly in air.	....	271	....	....	....	271	257	273	275	281
200	....	....	....	....	260	256	261	74k.	white ground.	....	271	....	....	....	271	257	273	275	281
201	....	....	....	....	260	256	261	74l.	Closing of lakes.	....	271	....	....	....	271	257	273	275	281
202	....	....	....	....	260	256	261	74m.	rivers.	....	271	....	....	....	271	257	273	275	281
203	....	....	....	....	260	256	261	74n.	Wild ducks migrating.	....	271	....	....	....	271	257	273	275	281
204	....	....	....	....	260	256	261	74o.	"	....	271	....	....	....	271	257	273	275	281
205	....	....	....	....	260	256	261	74p.	"	....	271	....	....	....	271	257	273	275	281
206	....	....	....	....	260	256	261	74q.	"	....	271	....	....	....	271	257	273	275	281
207	....	....	....	....	260	256	261	74r.	"	....	271	....	....	....	271	257	273	275	281
208	....	....	....	....	260	256	261	74s.	"	....	271	....	....	....	271	257	273	275	281
209	....	....	....	....	260	256	261	74t.	"	....	271	....	....	....	271	257	273	275	281
210	....	....	....	....	260	256	261	74u.	"	....	271	....	....	....	271	257	273	275	281
211	....	....	....	....	260	256	261	74v.	"	....	271	....	....	....	271	257	273	275	281
212	....	....	....	....	260	256	261	74w.	"	....	271	....	....	....	271	257	273	275	281
213	....	....	....	....	260	256	261	74x.	"	....	271	....	....	....	271	257	273	275	281
214	....	....	....	....	260	256	261	74y.	"	....	271	....	....	....	271	257	273	275	281
215	....	....	....	....	260	256	261	74z.	"	....	271	....	....	....	271	257	273	275	281
216	....	....	....	....	260	256	261	74aa.	"	....	271	....	....	....	271	257	273	275	281
217	....	....	....	....	260	256	261	74ab.	"	....	271	....	....	....	271	257	273	275	281
218	....	....	....	....	260	256	261	74ac.	"	....	271	....	....	....	271	257	273	275	281
219	....	....	....	....	260	256	261	74ad.	"	....	271	....	....	....	271	257	273	275	281
220	....	....	....	....	260	256	261	74ae.	"	....	271	....	....	....	271	257	273	275	281
221	....	....	....	....	260	256	261	74af.	"	....	271	....	....	....	271	257	273	275	281
222	....	....	....	....	260	256	261	74ag.	"	....	271	....	....	....	271	257	273	275	281
223	....	....	....	....	260	256	261	74ah.	"	....	271	....	....	....	271	257	273	275	281
224	....	....	....	....	260	256	261	74ai.	"	....	271	....	....	....	271	257	273	275	281
225	....	....	....	....	260	256	261	74aj.	"	....	271	....	....	....	271	257	273	275	281
226	....	....	....	....	260	256	261	74ak.	"	....	271	....	....	....	271	257	273	275	281
227	....	....	....	....	260	256	261	74al.	"	....	271	....	....	....	271	257	273	275	281
228	....	....	....	....	260	256	261	74am.	"	....	271	....	....	....	271	257	273	275	281
229	....	....	....	....	260	256	261	74an.	"	....	271	....	....	....	271	257	273	275	281
230	....	....	....	....	260	256	261	74ao.	"	....	271	....	....	....	271	257	273	275	281
231	....	....	....	....	260	256	261	74ap.	"	....	271	....	....	....	271	257	273	275	281
232	....	....	....	....	260	256	261	74aq.	"	....	271	....	....	....	271	257	273	275	281
233	....	....	....	....	260	256	261	74ar.	"	....	271	....	....	....	271	257	273	275	281
234	....	....	....	....	260	256	261	74as.	"	....	271	....	....	....	271	257	273	275	281
235	....	....	....	....	260	256	261	74at.	"	....	271	....	....	....	271	257	273	275	281
236	....	....	....	....	260	256	261	74au.	"	....	271	....	....	....	271	257	273	275	281
237	....	....	....	....	260	256	261	74av.	"	....	271	....	....	....	271	257	273	275	281
2																			

PHENOLOGICAL OBSERVATIONS IN

THE PHENOLOGY OF NOVA SCOTIA, 1919.—Continued.

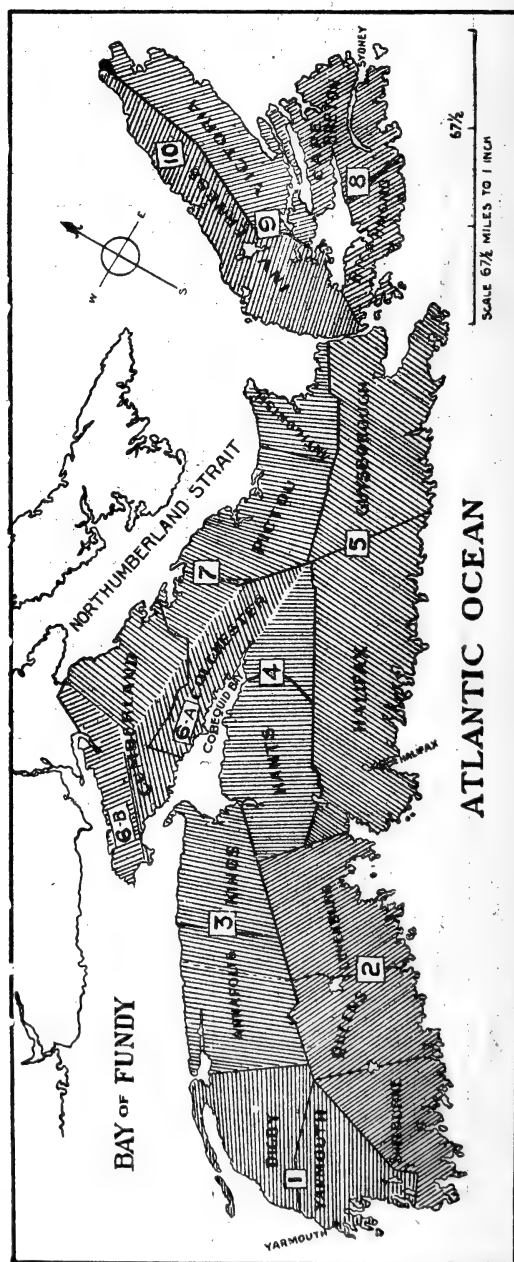
WHEN FIRST SEEN.		YEAR 1919.		WHEN BECOMING COMMON.	
OBSERVATION REGIONS.		Day of the year corresponding to the last day of each month.	Average Dates	OBSERVATION REGIONS	
1. Yarmouth and Digby	2. Shelburne, Lunenburg and Queens			3. Annapolis and Kings	4. Hants and Colchester
5. Halifax and Guysboro	6. Cobequid Slope	of each month.	Average Dates	6b. Chignecto Slope	7. Northum. Sts. Slope
8. Richmond and Cape Breton	9. & 10. Inverness and Bras d'Or Slope			9. & 10. Inverness and Bras d'Or Slope	9. & 10. Inverness and Bras d'Or Slope
139	142	Jan. 31	146	145	137
140	143	Feb. 29	147	146	138
141	144	March 31	148	147	139
142	145	April 30	149	148	140
143	146	May 31	150	149	141
144	147	June 30	151	150	142
145	148	For Leap Year add one to each except January.	152	151	143
146	149	19. Prunus Pennsylvanica, fruit ripe	153	152	144
147	150	20. " " " fruit ripe	154	153	145
148	151	21. Vaccinium Can. and Penn. fruit ripe	155	154	146
149	152	22. " " " fruit ripe	156	155	147
150	153	23. Ranunculus acris	157	156	148
151	154	24. R. repens	158	157	149
152	155	25. Th. erythrocarpum	159	158	150
153	156	26. Rhododendron Rhodora	160	159	151
154	157	27. Cornus Canadensis	161	160	152
155	158	28. " " " fruit ripe	162	161	153
156	159	29. Trientalis Americana	163	162	154
157	160	30. Clintonia borealis	164	163	155
158	161	31. Calla palustris	165	164	156
159	162	1. Cyripedium acaule	166	165	157
160	163	2. Sisyriochium angustifol.	167	166	158
161	164	3. Linnæa borealis	168	167	159
162	165	4. Kalmia glauca	169	168	160
163	166	5. " " "	170	169	161
164	167	6. Kalmia angustifolia	171	170	162
165	168	7. Crataegus oxyacantha	172	171	163
166	169	8. Crataegus coccinea, etc.	173	172	164
167	170	9. Iris versicolor	174	173	165
168	171	10. Chrysanthemum Leucanth.	175	174	166
169	172	11. Nuphar advena	176	175	167
170	173	12. Rubus strigosus	177	176	168
171	174		178	177	169
172	175		179	178	170
173	176		180	179	171
174	177		181	180	172
175	178		182	181	173
176	179		183	182	174
177	180		184	183	175
178	181		185	184	176
179	182		186	185	177
180	183		187	186	178
181	184		188	187	179
182	185		189	188	180
183	186		190	189	181
184	187		191	190	182
185	188		192	191	183
186	189		193	192	184
187	190		194	193	185
188	191		195	194	186
189	192		196	195	187
190	193		197	196	188
191	194		198	197	189
192	195		199	198	190
193	196		200	199	191
194	197		201	200	192
195	198		202	201	193
196	199		203	202	194
197	200		204	203	195
198	201		205	204	196
199	202		206	205	197
200	203		207	206	198
201	204		208	207	199
202	205		209	208	200
203	206		210	209	201
204	207		211	210	202
205	208		212	211	203
206	209		213	212	204
207	210		214	213	205
208	211		215	214	206
209	212		216	215	207
210	213		217	216	208
211	214		218	217	209
212	215		219	218	210
213	216		220	219	211
214	217		221	220	212
215	218		222	221	213
216	219		223	222	214
217	220		224	223	215
218	221		225	224	216
219	222		226	225	217
220	223		227	226	218
221	224		228	227	219
222	225		229	228	220
223	226		230	229	221
224	227		231	230	222
225	228		232	231	223
226	229		233	232	224
227	230		234	233	225
228	231		235	234	226
229	232		236	235	227
230	233		237	236	228
231	234		238	237	229
232	235		239	238	230
233	236		240	239	231
234	237		241	240	232
235	238		242	241	233
236	239		243	242	234
237	240		244	243	235
238	241		245	244	236
239	242		246	245	237
240	243		247	246	238
241	244		248	247	239
242	245		249	248	240
243	246		250	249	241
244	247		251	250	242
245	248		252	251	243
246	249		253	252	244
247	250		254	253	245
248	251		255	254	246
249	252		256	255	247
250	253		257	256	248
251	254		258	257	249
252	255		259	258	250
253	256		260	259	251
254	257		261	260	252
255	258		262	261	253
256	259		263	262	254
257	260		264	263	255
258	261		265	264	256
259	262		266	265	257
260	263		267	266	258
261	264		268	267	259
262	265		269	268	260
263	266		270	269	261
264	267		271	270	262
265	268		272	271	263
266	269		273	272	264
267	270		274	273	265
268	271		275	274	266
269	272		276	275	267
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271	274		278	277	269
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359	362		366	365	357
360	363		367	366	358
361	364		368	367	359
362	365		369	368	360
363	366		370	369	361
364	367		371	370	362
365	368		372	371	363
366	369		373	372	364
367	370		374	373	365
368	371				

THE PHENOLOGY OF NOVA SCOTIA, 1919.—Continued.

WHEN FIRST SEEN.										WHEN BECOMING COMMON									
OBSERVATION STATIONS										OBSERVATION REGIONS									
1. Yarmouth and Digby	2. Shelburne, Lunenburg and Queens	3. Annapolis and Kings	4. Hants and Colchester	5. Halifax and Guysboro	6a. Cobequid Slope	6b. Chignecto Slope	7. Northumb. Sts. Slap	8. Richmond and Cape Breton	9 & 10. Inverness and Bras d'Or Slope	OBSERVATION REGIONS									
Average dates										Average dates									
Day of the year corresponding to the last day of each month.										Day of the year corresponding to the last day of each month.									
79	104	96	88	85	92	91	93	98	92	83	Melospiza fasciata.	"	"	"	"	"	"	"	"
86	79	75	76	100	76	85	95	82	84	84	Turdus migratorius	"	"	"	"	"	"	"	"
88	82	92	90	106	90	92	74	74	90	85	Junco hiemalis	"	"	"	"	"	"	"	"
127	128	118	121	125	122	134	137	99	119	86	Actitis macularia	"	"	"	"	"	"	"	"
131	104	132	125	125	122	135	137	74	122	87	Sturnella magna	"	"	"	"	"	"	"	"
123	128	118	121	125	122	134	137	74	122	88	Ceryle alcyon	"	"	"	"	"	"	"	"
126	131	138	135	136	142	143	133	152	138	89	Dendroica coronata	"	"	"	"	"	"	"	"
119	119	108	120	130	145	118	135	147	128	90	D. aestiva	"	"	"	"	"	"	"	"
129	150	147	147	144	144	147	142	155	145	91	Zonotrichia alba	"	"	"	"	"	"	"	"
139	139	134	136	138	152	138	151	158	143	92	Trochilus colubris	"	"	"	"	"	"	"	"
143	143	144	139	147	138	139	147	138	138	93	Tyrannus Carolinensis	"	"	"	"	"	"	"	"
102	102	155	149	145	141	143	141	143	142	94	Dolichonyx oryzivorus	"	"	"	"	"	"	"	"
127	100	155	150	149	166	152	145	141	141	96	Setophaga ruticilla	"	"	"	"	"	"	"	"
91	129	136	141	129	139	134	136	103	135	97	Ampelis cedrorum	"	"	"	"	"	"	"	"
86	89	101	101	101	101	101	109	104	129	98	Chordeiles Virginianus	"	"	"	"	"	"	"	"
90	102	110	112	114	122	121	116	108	110	100	First appearance, snakes.	"	"	"	"	"	"	"	"

THE LOCAL COMPILERS FOR EACH REGION, 1919.

Region No.	Region No.
I. Miss Jennie C. Allan	VIa. Miss Vera M. Allen
II. Miss C.A. Zinck	VIIb. " " "
III. Miss Zaidee Horsfall	VII. Miss Fannie M. Layton
IV. Miss Gertrude M. Chase	VIII. Mr. Wilbert Spencer
V. Miss J. D. Stoddard	IX & X. Miss Gladys MacLeod



THE TEN PHENOLOGICAL REGIONS OF NOVA SCOTIA.

THUNDERSTORMS—PHENOLOGICAL OBSERVATIONS, NOVA SCOTIA, 1918-1919.

The indices indicate the number of stations from which the Thunderstorms were reported on the day of the year specified.

OBSERVATION REGIONS.

1. Yarmouth and Digby.	2. Shelburne, Queens and Lunenburg.	3. Annapolis and Kings.	4. Hants and Colchester	5. Halifax and Guysboro.	6a. Cobequid Slope, (to the South)	6b. Chignecto Slope (to the north)	7. Northumb. Sts. Slope (to the north)	8. Richmond and Cape Breton.	9. Bras d'Or Slope Inverness Slope	10. Total 1919
		107	108 109 ⁷ 111	109 ²			91 99	64		64 91 99
							108 109 ²			107 108 ² 109 ¹¹
115							115	112		111 112 115
					122 125 ²			120		120 121 122
125 ² 126	125 ³	125	125 ³				125 ¹³	125 ³	125 ⁶	125 ³³ 126 127
				134 135			127 134 ² 135	134	134 ⁴	134 ⁸ 135 ² 137
	138		138						137	138 ² 141
145			145				141			145 ² 146 ³ 147 ²
147				146	146 ² 147 149					149 ⁵ 152
	149	149 ² 152						149		
155										155
	156 ³		156 ⁶				156 ⁴ 157 ⁵ 158 ⁶	156 157	156 157 158	156 ¹⁵ 157 ⁸ 158 ²¹
		158 ²	158 ⁶	158	157 158 ⁵ 161		161 168			161 ² 168 ⁷
168	168 ²	168 ²		168						
		170 171 ³ 172	170 171 ³ 172 ¹³	170	170 171 172 ²		170 ² 171 172 ¹⁰	170 171		170 ⁷ 171 ¹³ 172 ³²
172			173						172	173

The indices indicate the number of stations from which the Thunderstorms were reported on the day of the year specified.

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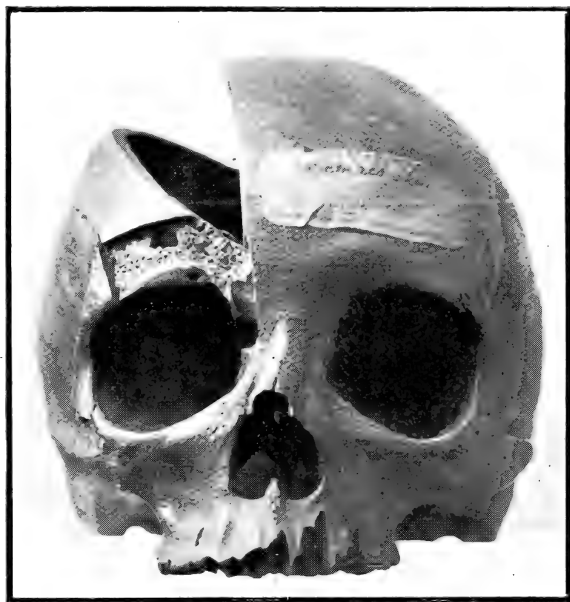


Fig. 11. Front view of the Micmac Skull. *Norma frontalis.*

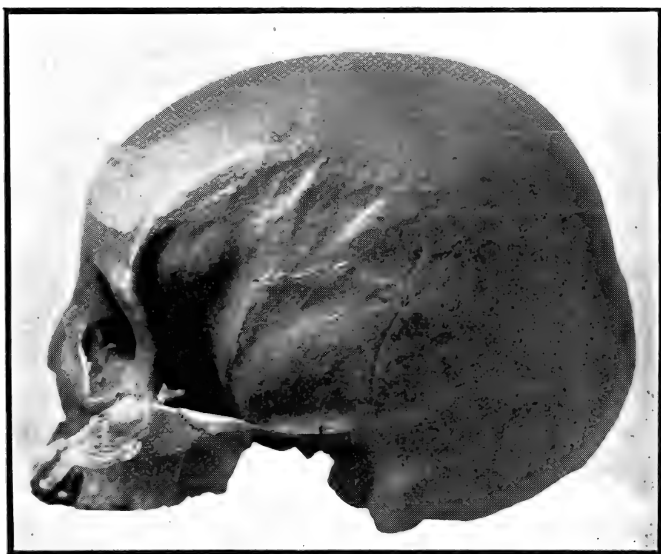


Fig. 12. Lateral view of the Micmac Skull. *Norma lateralis.*

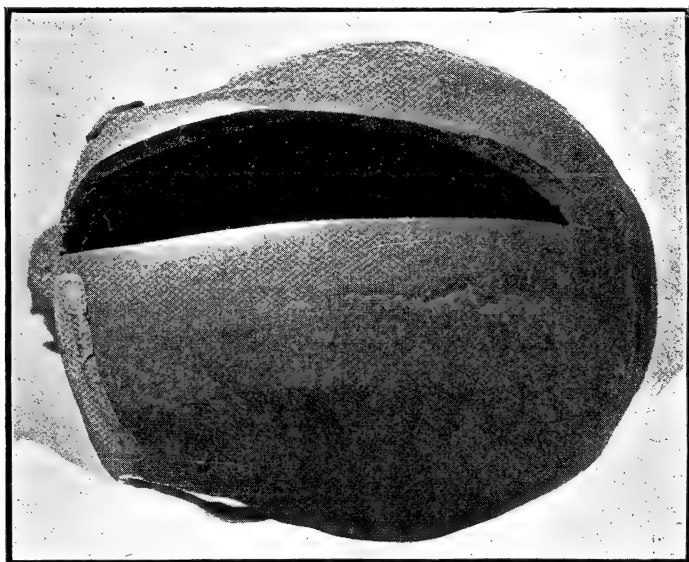


Fig. 13. The Micmac Skull viewed from above. *Norma verticalis*.

